Methods of optical spectroscopy in detection of virus in infected samples: A review

ABSTRACT

Due to the recent COVID-19 pandemic that occurred worldwide since 2020, scientists and researchers have been studying methods to detect the presence of the virus causing COVID-19 disease, namely SARS-CoV-2. Optical spectroscopy is a method that employs the interaction of light in detecting virus on samples. It is a promising method that might help in detecting the presence of SARS-CoV-2 in samples. Four optical spectroscopy methods are discussed in this paper: ultraviolet (UV), infrared (IR), Raman spectroscopy and fluorescence spectroscopy. UV and IR spectroscopy differ in wavelength range (less than 400 nm for UV, more than 700 nm for IR). Raman spectroscopy involves shift in wavelength due to scattering of light. Fluorescence spectroscopy involves difference in wavelength between absorbed and emitted light due to vibrational relaxation. These four methods had been proven to differentiate healthy samples from virus-infected samples. UV spectroscopy is useful in determining presence of virus based on 260 nm/280 nm absorbance ratio. However, its usefulness is limited due to its destructive properties on virus at sufficiently high intensity. Meanwhile, IR spectroscopy has becoming popular in studies involving virus samples. Mid-infrared (MIR) spectroscopy is most commonly used among IR spectroscopy as it usually provides useful information directly from spectral data. Near infrared (NIR) spectroscopy is also used in studying virus samples, but additional methods such as principal component analysis (PCA) and partial least squares (PLS) are required to process raw spectral data and to identify molecules based on spectral peaks. On the other hand, Raman spectroscopy is useful because spectral data can be analyzed directly in identifying vibrational modes of specific molecules in virus samples. Fluorescence spectroscopy relies on interaction between viral particles and fluorescent tags for the detection of virus based on improvement or quenching of fluorescent signal. Due to non-invasive properties of virus samples, IR, Raman and fluorescence spectroscopy will be used more often in future studies involving virus detection in infected samples.