Calibration of Human Spectral Data by using Aqueous Glucose Solutions Prepared via Serial Dilution Methods

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Presently, diabetics need to obtain a direct blood sample to monitor their blood glucose levels. Our goal is to make available a non-invasive blood glucose monitoring system that detects glucose in interstitial fluid in the dermal layer of the integument. Previous research has indicated that glucose is detectable in aqueous solutions in concentrations of 20-400+ mg/dL ± 21 mg/dL with 90% confidence using mid-infrared (mid-IR) laser technology [1]. Our group found a predictable ratio of nearly 1:1 when comparing expected and actual values of glucose in porcine serum and Intralipid\textsuperscript{2}[2]. Also, \textit{in vitro} measurements of glucose were shown to be predictable in the mid-IR[3], and \textit{in vivo} measurements using human subjects have shown promising results [4]. Over the past year, a faster scanning laser set-up was utilized, which ultimately proved to have a higher resolution. For this reason, the previously calibrated aqueous measurements need to be refined.

Currently, we are working on calibration measurements using new glucose sample solutions prepared by serial dilution method with the intent of re-establishing a means of which to compare human spectral data. We are using a Fourier Transform Infrared spectrometer (FTIR) with a new sample cell to detect glucose in aqueous solutions with the eventual goal of normalizing human spectral data taken with the improved laser set-up. We measured the absorbance of glucose in serial dilutions ranging from 400 mg/dL to 67 mg/dL and ran 3 trials for each dilution, using a spectral range of 4000-650 cm\textsuperscript{-1}. There are multiple absorption features, with the strongest features present between 1033 and 1077 cm\textsuperscript{-1}. In order to provide a basis for comparison, we will be further quantifying the absorption feature changes against the concentration changes.

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![Transmittance of Glucose in an Aqueous Solution as a Function of Wavenumber](image1)

Fig. 1 (Left) The spectral features of any concentration of glucose in aqueous solution are difficult to detect and quantify when viewing the spectral range from 650-4000 cm\textsuperscript{-1}. The red box indicates the range of interest, as glucose is detected in the range between 1000-1250 cm\textsuperscript{-1}. (Right) A serial dilution of glucose in aqueous solution shows clear spectral features at 1075 cm\textsuperscript{-1} and 1225 cm\textsuperscript{-1}. Higher concentrations of glucose in solution show deeper absorption features.