Abstract

An effective method based on reference point for glucose sensing at 1100-1600 nm

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Introduction

In the past few decades, various optical methods have been developed to obtain quantitative blood glucose information from the human body non-invasively. However, an effective non-invasive method for clinical glucose sensing has not been realised yet. The difficulty is that non-invasive glucose transducers should be capable of detecting weak blood signals through strong background interferences of intervening tissues. It was deemed important to find a correction method to eliminate background interferences.

Materials and Methods

Based on a Monte Carlo simulation result on a 5% intralipid solution model, we designed a probe which has two sensing points (a reference point and a measuring point) where the diffuse reflectance intensity is insensitive and most sensitive to the variation of glucose concentration respectively. A double optical path system sensing diffuse reflection spectra via a probe from 1100-1600 nm at intervals of 10 nm was built for the glucose sensing. Samples (n = 21) of 5% intralipid solution with glucose from 0-2000 mg/dL at intervals of 100 mg/dL were measured in random order. After normalisation, the corrected data were computed by ratioing the spectra of measurement point to spectra of the reference point. Using corrected data, a full cross-validation PLS regression model was performed by The Unscrambler (CAMO, Norway).

Results and Discussion

The corrected data have much better curve distribution along the glucose concentration than the data which were computed by ratioing the spectra of the measurement point with the background spectra of the pure solution of 0 mg/dl glucose. Compared with the model built by ratioing the background spectrum, the RMSEP and RMSEC of PLS model built by the corrected data had dramatically improved accuracy to 86.40 mg/dL from 157.38 mg/dL and to 73.92 mg/dL from 108.95 mg/dL, reduced by 45.10% and 32.15% respectively.

Conclusion

On the basis of the glucose concentration curve distribution and the RMSEP and RMSEC of the PLS model, it has been demonstrated that this reference correction method can eliminate strong background interferences effectively and decrease the prediction error during glucose sensing.

Reference paper as:
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Infrared Spectroscopy, Edited by M. Manley,C.M. McGoverin, D.B. Thomas and G. Downey, Cape Town, South Africa, p. 247.