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Near-infrared reflectance spectroscopy for noninvasive monitoring of metabolites

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Abstract

An important class of substances in clinical chemistry are metabolites in body fluids, which are accessible by near-infrared spectroscopy without sample treatment using reagentless, fast and readily automated in vitro assays. Furthermore, noninvasive sensing systems are under development for the determination of blood glucose, especially for diabetic patients or for monitoring in intensive care and surgery. Near-infrared diffuse reflectance spectrometry of skin was employed allowing a certain tissue volume to be integrally probed. For calibration, the partial least-squares (PLS) algorithm was used either based on wide spectral intervals or using special spectral variable selection. Capillary blood glucose reference concentrations were obtained by finger pricking and an automated laboratory method (hexokinase/G6P-DH). Clear evidence is provided for the physical effect, as manifested by the spectral glucose absorptivities, underlying the individual single-person calibration models, which still require improvements in the methodology in the normo- and hypoglycemic concentration range. In extending the potential of noninvasive blood assays by infrared spectroscopy, a novel technique is presented for probing the intravascular fluid space by using fast spectral near-infrared measurements of skin tissue. The pulsatile blood spectrum can be derived from reflectance spectra of oral mucosa by Fourier analysis (near-infrared plethysmography). Future applications and prospects for noninvasive blood assays are discussed.

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