ATR-FTIR spectral monitoring of burn wound healing in skin by hierarchical cluster

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Efficient biochemical characterization of burn wound healing stages can improve clinical routine to adjust the patient treatment. The Fourier Transform Infrared spectroscopy coupled with Attenuated Total Reflectance (ATR-FTIR) is an analytical technique that has potential capability to provide spectral biomarkers in biological material. This study aims to evaluate the feasibility of using ATR-FTIR to classify burned skin, to be able, in the future, to follow the regenerative process in patients. Wistar rat burn tissues were evaluated by ATR-FTIR spectroscopy at 3, 7, 14, 21 days after burn and compared with the healthy group samples (H). For the acquisition of one spectrum, 150 scans were averaged with a resolution of 4 cm^{-1} and wavenumbers ranging from 4000 to 400 cm^{-1}. Analysis of the spectra was performed using MatLab R2017a (MathWorks, EUA) software. The fingerprint region between 900 to 1800 cm^{-1} was separated and normalized by amide I band area. For smoothing purpose, spectra were submitted to Savitzky-Golay filter with a polynomial of second order in a fifteen points window. All spectra data were submitted to the hierarchical cluster using the single method and standardized Euclidean distance. The classification results demonstrated separation to non-wounded groups with an accuracy of 91,8% (H vs. 3D), 87,83% (H vs. 7D) and 97,96% (H vs. 14D). Interestingly, when the results from the healthy group were compared to the 21D group, the accuracy dissimilarity was 26%, which suggests that they are chemically similar implying that after 21 days the burned lesions are entirely recovered. These findings indicate that when an adequate multivariate method is applied, ATR-FTIR is suitable to detect the wounded and non-wounded skin as well as its healing stages. In this way, it is possible to conclude that ATR-FTIR can be an auxiliary analysis for the clinical routine for skin burn wound healing. This study was supported by CAPES/PROCAD 88881.068505/2014-01 and CNPq/INCT 465763/2014-6.