

Investigating the molecular structure of plasma in type 2 diabetes mellitus and diabetic nephropathy by synchrotron Fourier-transform infrared microspectroscopy

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Abstract: Diabetes mellitus (DM) is associated with a high incidence of morbidity and mortality which, in many cases, is derived from the progressive kidney dysfunction due to diabetic nephropathy (DN). In this study, synchrotron-Fourier-transform infrared (SR-FTIR) microspectroscopy was used to identify molecular changes in the lipid and protein regions in the plasma of patients with different stages of DN (mild, moderate, severe and end-stage), and patients with type 2 diabetes mellitus (T2DM) without DN. Our results revealed different conformational changes in the proteins secondary structure between DN stages, and between DN and T2DM groups illustrated by peak shifts and intensity alterations. End-stage DN showed the highest CH₂/CH₃ ratio and intensity of the carbonyl group in protein-carbonyl region compared to other DN stages indicating high level of unsaturation and lipid peroxidation and oxidation conditions. Moreover, end-stage DN group was characterized by a decrease in amide I and amide II absorption signals which reflected a sign of hypoalbuminemia. When compared to T2DM, DN group demonstrated a higher oxidation state as confirmed via the high intensity of the carbonyl group and the high level of malondialdehyde. The current study highlights the promising role of SR-FTIR microspectroscopy as a new sensitive analytical approach that can be used to provide better understanding of the pathophysiology of DN, and guide the development of new preventive therapies and treatments.