μ-FTIR and μ-XRF synchrotron-based spectroscopic studies of atherosclerotic plaques of apoE-knockout mice

J. Kowalska[1], M. Gajda[2], P. Dumas[3], K. Appel[4] and W. M. Kwiatek[1]

[1]Institute of Nuclear Physics PAN, Radzikowskiego 152, 31-342 Kraków, Poland
[2]Department of Histology, Jagiellonian University Medical College, Kopernika 7, 31-034 Kraków, Poland
[3]French Synchrotron Facility SOLEIL, GIF-sur-YVETTE CEDEX, France
[4]Hasylab, DESY, Notkestraβe 85, D-22607, Hamburg, Germany

Atherosclerosis is a multietiological inflammatory disease involving large and medium-sized arteries. Despite many intense studies, the patomechanism of this disease is still not fully understood. The creation of gene-targeted mice opened new horizons to investigate the pathogenesis and treatment of this disease. ApoE-knockout mice display early and advanced vascular lesions including lipid deposits and inflammatory cell infiltration as well as valvular calcifications.

Spectroscopic techniques have become valuable tools to study biological systems. Since tissue samples are very complex structures, the application of only one technique does not disclose all expected information. Combining the distribution and concentration of trace elements and macromolecules with histological stainings seems to be an adequate approach to get a complete physicochemical analysis of studied systems.

The aim of the present study was to investigate changes in the distribution of selected pro- and anti-inflammatory elements as well as differences in macromolecule ratios in atherosclerotic plaques of apoE-knockout mice fed chow diet supplemented or not with AVE 0991 - angiotensin (1-7) receptor agonist (a potential candidate for atherosclerosis treatment) [1]. We combined synchrotron radiation micro-FTIR and micro-XRF spectroscopy with histological examination to determine the concentration of trace elements and the distribution of macromolecules in histologically defined areas of atherosclerotic plaques.

Histological stainings showed more advanced atherosclerosis in control animals treated with diet not supplemented with AVE 0991. The presented analysis is focused on the atheroma area (oil red-O staining) of plaques in both analyzed group. The treatment with AVE 0991 caused the increase of P, S, Ca, Cu, Zn and Se concentrations and decrease of Cl, K and Fe in atheromas as compared to the control group. [2] The FTIR analysis was mainly based on differences in relative secondary structure of proteins, saturation levels of phospholipids and lipid to protein ratio. Moreover, some attempts were made to identify particular mineral deposits in atherosclerotic plaques and in aortic valves.

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