Elemental imaging in thin sections of mouse aortas

Dagmar Urgast[1], Andrea Raab[1], John Beattie[2] Jörg Feldmann[1]

[1]TESLA (Trace Element Speciation Laboratory), University of Aberdeen, College of Physical Science, Chemistry, Meston Walk, Aberdeen AB24 3UE, Scotland, UK

[2] Rowett Institute of Nutrition and Health, University of Aberdeen, Greenburn Road, Bucksburn, Aberdeen AB21 9SB, Scotland, UK

Heart disease is a major cause of death in the European population and the build up of fatty deposits in important blood vessels can eventually cause a heart attack. Oxygen and other reactive compounds cause damage to living cells and this it what often starts and promotes the deposition of fatty deposits in blood vessels. Zinc is a micronutrient which protects against the reactive compounds that cause oxidation in cells. It is therefore potentially protective against oxidative damage to blood vessel tissue and, conversely, zinc deficiency might be expected to encourage vascular cell damage.

The aim of this project is to determine whether zinc deficiency at levels relevant to the UK human population can affect the development of vascular disease. Therefore feeding experiments with ApoE knock out mice were carried out exposing the mice to low, medium and normal zinc concentrations in their diet. Thin sections (35 µm thickness) of the mice aortas were prepared and then analysed using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) to generate images showing the distribution of ^{13}C, ^{24}Mg, ^{31}P, ^{34}S, ^{44}Ca, ^{65}Cu, ^{57}Fe, ^{55}Mn, ^{66}Zn in the thin sections. The laser used was a LSX 200+ 266 nm Nd:YAG laser from CETAC with a large ablation cell. Spot size and speed of translation stage were optimised using 0.2 mm thick lines (distance 0.76 mm) printed by a laser printer on paper. Optimum conditions, considering time and resolution, were found to be 100 µm spot size coupled with 25 µm/s translational speed and a distance between lines of 200 µm. Integration time for the elements varied between 10 ms (13C) and 100 ms (55Mn and 66Zn).

The distribution of carbon intensity followed the distribution of actual tissue in the sections and therefore allowed this element to be used as internal standard. This was used to cancel out any variability in tissue thickness, ablation efficiency and laser output in order to generate semi-quantitative element maps of the tissues. The distribution of Mg, P and S was relative homogeneous within the tissue, whereas especially Ca showed strong localisation effects indicating calcification of the aortas. This shows that semi-quantitative element maps can be used to identify element distribution and hot spots of elements in tissue thin sections.

Acknowledgement: This project is funded by the Korean Research Foundation (KRF-2008-220-F00013).