Specification and quantitative magnetic analysis of iron-containing species in animal tissues using SQUID magnetometry.

M. Škrátek,[1] M. Kluknavský,[2] I. Bernátová,[2] and J. Maňka[1]

[1] *Institute of Measurement Science, Slovak Academy of Sciences, Bratislava, Slovakia*

[2] *Centre of Experimental Medicine, Slovak Academy of Sciences, Institute of Normal and Pathological Physiology, Bratislava, Slovakia*

Iron, as an important element, is involved in various biological processes, whether as a component of cytochromes, oxygen-binding molecules or various enzymes. Iron is toxic, has the potential to generate reactive oxygen species, nearly all iron in the body must be incorporated into iron-containing organic substances such as hemoglobin, myoglobin, ferritin or transferrin. Detection and quantification of iron plays an important role in monitoring its distribution in individual tissues or blood. Standard methods of determining the content of elements like Inductively Coupled Plasma Atomic Emission Spectroscopy or Atomic Absorption Spectroscopy do not allow the content of individual components to be determined in one step. This work focuses on investigating the magnetic properties of such iron-containing species, their analysis, and understanding how magnetic properties reflect their concentration and combination in tissues. It was found that each substance has its own characteristic magnetic properties, which are reflected in the resulting properties of tissues and blood. Based on our previous work with the determination of the content of superparamagnetic iron-oxide nanoparticles in tissues [1], as well as the relative content of biogenic iron [2], it was decided in this study to use hysteresis measurements at a temperature of 2 K. In order to determine amount of iron in minute samples from laboratory animals (rats), the concentration dependences of individual iron–containing compounds were derived. Iron concentration depending of type was determined in samples of liver, heart and blood.

References:

[1] M. Škrátek et al., Nanomaterials, 10(10, 2020), 1993

[2] M. Kluknavský et al., Physiological Research, 74 (2025), S271-S283

Funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V04-00528.