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### Determination of the lead and lead oxides concentration in human biological and environmental samples using X-ray spectrometry techniques

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Elemental analysis of the human biological material (serum, urine, hair) carries the essential information about the state of the organism. Determination of the lead concentration, which is present in all tissues of the human body, is an example of a such analysis. The lead concentration is mostly a function of its content in the environment and the time of impact on human body. Lead inserted into the body goes almost entirely into the blood. Part of it is deposited in bone, soft tissue, hair, and the rest is eliminated. The lead content in the blood is a sensitive indicator of risk of the organism [1].

In the presented studies, the concentration of lead in the samples of the human biological material was determined by total reflection X-ray fluorescence analysis (TXRF) technique using the PICOFOX spectrometer (Bruker). Due to expected concentration of lead close to the detection limit of the TXRF method (ppb range) optimization of the measuring procedure (sample preparation, internal standard selection, measurement time, quantitative calibration of the spectrometer) is necessary. In this work the physical basis of TXRF method, an experimental setup, sample preparation procedure of human biological material and spectrometer calibration will be discussed.

Parallel, the lead concentration and content of lead oxides will be determined in environmental samples (water, soil, minerals, sediments) using X-ray spectrometry and diffraction techniques (TXRF, WDXR, XRPD). The main motivation of the studies is optimization measurement procedure and determination the detection limit of lead and lead oxides for each analysed samples and used analytical techniques.

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[1] A. Kabata-Pendias, A. B. Mukherjee, *Trace Elements from Soil to Human* (Springer, 2007).

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### Application of the X-ray spectrometry methods in analysis of the diet supplements

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The registration and marketing of medicative products and medicinal devices are directly related to their quality, safety and therapeutic efficacy. The analysis of the drugs concentrates on bioavailability and bioequivalence studies, on their elemental and chemical composition and possible impurities.

The topic of this report is the application of the X-ray spectrometry methods in analysis of the pharmaceutical samples. In presented studies different commercially available diet supplements containing trace elements essential for the proper functioning of the human body, namely: Mg, Cr, Se and Zn [1], will be analysed using WDXRF, TXRF and XRPD techniques. The studies concentrate on elemental and chemical composition analysis. Firstly, the sample preparation requirements for applied techniques will be optimized (needed amount of sample, necessity for sample digestion, matrix effects, quantitative calibration). For TXRF method the choice of internal standard will be also discussed. Next, the conditions of the measurements will be optimized and discussed in context of sensitivity of the methods for different elements and compounds. As a result, the elemental (respectively Mg, Cr, Se and Zn) and chemical composition of the diet supplements will be obtained. The analysis of pharmaceutical samples will include also identification of the samples impurities and estimation of the detection limit. The composition of studied different diet supplements will be compared and interpreted using the statistical method BIPLLOT.

The presented studies can be next applied in topic of the detection of the medicament in human biological material. As an example from our laboratory, monitoring of selenium concentration in the serum of patients with thyroid diseases treated with selenium will be discussed.

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