Streszczenie w języku angielskim

The skeletal system is seen as a structure performing mechanical and metabolic functions, however, due to its constant reconstruction, it accumulates various substances, including toxic elements. It should be noted that despite this, it is almost never the subject of toxicological studies due to experimental issues. Bones, as calcified tissues, contain collagen and hydroxyapatite, which allows the incorporation of heavy metals, such as Pb, Cd or Sr, through ion exchange, which can affect bone properties. Sources of exposure to toxic elements include water, food, industrial waste and everyday objects. Due to the accumulation of toxic elements in bones, they are important in forensic toxicology, especially in cases of long-term exposure or body decomposition. Currently used methods for determining these elements, including ICP-MS or ASA, are characterized by complicated sample preparation causing its destruction, long analysis times and high costs. Hence, the aim of this dissertation was to develop a specific method (*in situ*, non-destructive, fast, "white" and field) enabling the determination of toxic elements (Pb, Cd, Sr) in human bones, using a portable pXRF spectrometer for the needs of forensic toxicology for the justice system and law enforcement agencies.

In order to achieve this aim, methods were developed for determining the above-mentioned elements in bones by developing and optimizing an original procedure for producing solid standards in bones using a hydraulic press, using the NIST 1400 standard and certified reference materials. The developed methods were based on measurements in the soils mode and the selection of the appropriate fluorescence band.

To optimize analysis time while maintaining precision, measurements were performed on a 2-gram sample of the NIST 1400 standard using specialized XRF measuring cups, consisting of a low X-ray absorption body, a polypropylene film (4 μm) and a clamping ring, which allows stable X-ray penetration. Measurements were performed at 60 s and 600 s for Sr and Pb. The 600 s results for Sr (241.32 ± 1.78 μg/g) and Pb (9.43 ± 1.29 μg/g) were most similar to the certified values (Sr: 249.00 ± 7.00 μg/g; Pb: 9.07 ± 0.12 μg/g) and had a lower uncertainty (2σ). The results of the 60-second measurements showed larger deviations, but remained relatively close to the certified values.

Using the NIST 1400 standard, calibration curves were developed for Sr in the concentration range of 6.23 to 249.00 μg/g. The calibration curves were developed based on the results of the

soils mode measurements and the selection of the fluorescence band. Both curves were characterized by a good linear correlation coefficient of R = 0.9984 and R = 0.9967, respectively.

Using certified reference materials, methods for determining Pb, Cd and Sr were developed. As in the case of the previous method, calibration curves were created in the range for Pb 12.50 to 200.00 μg/g for both the direct measurement and band selection methods, for Cd 1.60 to 3.40 in the soils mode method and 0.40 to 3.40 μg/g in the fluorescence band selection method, for Sr a curve in the range 40.00 to 300.00 μg/g was created in both methods. All calibration curves had linear correlation coefficients R > 0.99 except for the curve for Cd in the fluorescence band selection method, where this coefficient was slightly lower: R = 0.9802.

As a result of comprehensive validation, it was confirmed that the developed methods meet the rigorous requirements for methods used in forensic investigations. All developed methods were characterized by relative standard errors below 5%, which allowed them to be classified as quantitative methods.