INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF RIB BONE SAMPLES AND BONE REFERENCE MATERIALS

MITIKO SAIKI, MARCELO K. TAKATA, SILA KRAMARSKI, AURELIO BORELLI*

Instituto de Pesquisas Energeticas e Nucleares, IPEN-CNEN/SP, Radiochemistry Division, P.O. Box 11 049, CEP 05422-970, Sao Paulo, SP, Brazil
**Fac. Medicina - USP, Av. Dr Arnaldo 455, CEP 01246-903, Sao Paulo, SP, Brazil*

In the last years has been an increasing interest in the determination of trace elements in biological tissues in order to elucidate their roles in human beings as well as to diagnose diseases. Also, trace element determinations in bones have been carried out because essential and toxic elements are deposited in bones.

The purpose of this work was to establish the methodology of instrumental neutron activation method (INAA) to analyse bone tissues and provide results of trace element in rib bones. In order to evaluate the precision and the accuracy of the results, the reference materials NIST SRM 1400 Bone Ash and MST SRM 1486 Bone Meal were analysed. Human rib bone samples were obtained from accident victims' autopsies performed at the Institute of Forensic Medicine of the Universidade Mogi das Cruzes, SP. The samples were wrapped in polyethylene foils and stored in a freezer until they were analysed. The ribs were dissected and cleaned free from connected soft tissues (marrow and periosteum) and then washed with distilled water. The small pieces of cortical bones were lyophilized for analyses.

Two procedures have being used for bone sample irradiation at the IEA-Rlm nuclear reactor. Irradiations of 1 min at the pneumatic rabbit station with thermal neutron flux of about 10^{12} n cm^{-2} s^{-1} were used to determine Ba, Ca, Cl, Mn, Na, P and Sr. Longer irradiations of 8 hours under thermal neutron flux of 10^{12} n cm^{-2} s^{-1} were also carried out for Ba, Br, Ca, Na, Sr, Sc, Cr and Zn determinations. After appropriate decay times, the gamma activities of the samples and standards were measured using an HGe detector. For P analysis, the beta activity of ^{32}p was measured in a Geiger Muller detector.

Elemental concentrations obtained in replicate analyses of rib samples indicated a good precision of our results with relative standard deviations varying from 3.8 to 14%. The less precise result was obtained for Fe probably due to the contamination of cortical bone with blood that contains high level of this element. The mean values found in the analyses of reference materials are, in general, in good agreement with those reported by NIST. The relative errors obtained are lower than 15 %. Results obtained for Ba, Cl, Mn and Na in the reference materials constitute a contribution for their certification.

The short irradiation procedure presented the advantage of quick response of the analyses and there was not spectral interference of bremsstrahlung produced by beta emission of ^{32}p Long irradiations were necessary to analyse the elements Br Fe, Sc and Zn. The lyophilization was the most convenient process for drying the sample because it did not cause any element losses. Samples prepared by calcination showed loss of Br and Cl. Comparison between the results obtained for different ribs from a same individual as well as for bones from different individuals did not show a significant difference. Besides, results obtained for ribs are within the range values reported in the literature for human bones. Results obtained in this work confirm that the INAA is a suitable method for bone analysis due to its

multielemental character, to the absence of destruction step and to the quality of their results.