

ESTIMATED EXPANDED UNCERTAINTY OF MEASUREMENT FOR FISH SAMPLES ANALYZED BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS

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Expanded measurement uncertainty is an estimate characterizing the range of values at which the true value of a measurand is at a defined confidence level. Expanded uncertainty is one of the three pillars of metrology, along with metrological traceability and methodological validation. Due to the importance of this parameter, it was estimated following the Guide to the Expression of Uncertainty in Measurement (GUM) for element measurement results obtained by Instrumental Neutron Activation Analysis (INAA) performed with short irradiations at the Pneumatic System of the IEA-R1 research reactor at IPEN – CNEN/SP. Samples of Brazilian sardine (*Sardinella brasiliensis*), one of the most consumed species in the city of São Paulo were analyzed and Br, Cl, Mg, Mn, Na and K were determined. For the analyzed elements, the values of expanded uncertainty with coverage factor $k = 2$ are lower than natural variation (standard deviation) of the elements mass fractions observed in a collected batch of 10 individual specimens.

NEUTRON ACTIVATION ANALYSIS CHARACTERIZATION PROCEDURES FOR FISH CONSUMED AT SÃO PAULO CITY

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The characterization of edible tissues of fishes consumed by humans is very important for determination of several toxic and potentially toxic elements, ensuring the food safety. The Instrumental Neutron Activation Analysis (INAA) comparative method allows the determination of several of these elements, as well as others, for example of nutritional character. This study is part of the International Atomic Energy Agency (IAEA) technical cooperation project of Latin America and Caribbean countries to ensure the quality of food and biomonitoring of contaminants in molluscs and fishes. Ten specimens of 5 of the most consumed fish in São Paulo city: whitemouth croaker (*Micropogonias Furnieri*), smooth weakfish (*Cynoscion learchus*), common snook (*Centropomus undecimalis*), Brazilian sardine (*Sardinella brasiliensis*) and bluefish (*Pomatomus Saltatrix*) were analyzed. Complete procedures for analysis, which includes purchase in the largest warehouse in Latin America, transport to the laboratory, storage, freeze-drying, milling, weighting and other preparations of the subsamples, and the short irradiation parameters for the determination of Br, Cl, K, Mn and Na are reported. Results obtained for macro and microelements are presented and are in agreement with analysis of oyster tissue and

mussel tissue certified reference materials under the same irradiation conditions, with zscore values ranging from -3.0 to 2.2.

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P16 **EVALUATION OF RADIONUCLIDE CONTAMINATION OF SOIL, COAL ASH AND ZEOLITIC MATERIALS FROM FIGUEIRA THERMOELECTRIC POWER PLANT**

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Neutron activation analysis and gamma-ray spectrometry were used to determine ²³⁸U, ²²⁶Ra, ²²⁸Ra, ²¹⁰Pb, ²³²Th and ⁴⁰K contents in feed pulverized coal, bottom ash, fly ash from cyclone and baghouse filters, zeolites synthesized from the ashes and two different soil samples. All the samples used in the study were collected at Figueira thermoelectric power plant, located in the city of Figueira, Parana State, where coal presents a significant amount of uranium concentration. The natural radionuclide concentrations in pulverized coal were 4216 Bq kg⁻¹ for ²³⁸U, 180 Bq kg⁻¹ for ²²⁶Ra, 27 Bq kg⁻¹ for ²²⁸Ra, 28 Bq kg⁻¹ for ²³²Th and 192 Bq kg⁻¹ for ⁴⁰K. The ashes fraction presented concentrations ranging from 683.5 to 1479 Bq kg⁻¹ for ²³⁸U, from 484 to 1086 Bq kg⁻¹ for ²²⁶Ra, from 291 to 1891 Bq kg⁻¹ for ²¹⁰Pb, from 67 to 111 Bq kg⁻¹ for ²²⁸Ra, from 80 to 87 Bq kg⁻¹ for ²³²Th and from 489 to 718 Bq kg⁻¹ for ⁴⁰K. Similar ranges were observed for zeolites. The activity concentration of ²³⁸U was higher than worldwide average concentration for all samples. The concentration of the uranium series found in the ashes were lower than the values observed in similar studies carried out 10 years ago and under the limit adopted by the Brazilian guideline (CNEN-NN-4.01). Nevertheless, the concentrations in this specific area are higher than in other coal mine and thermoelectric power plants in and out of Brazil, so it is advisable to evaluate the environmental impact of the installation.

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