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Comprehensive Review and Application of Neutron Activation Analysis for Elemental Concentration Analysis of Coffee Samples

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Neutron Activation Analysis (NAA) is a vital tool in the qualitative and quantitative measurement of elemental concentrations, with far-reaching applications in archaeology, geography, and agriculture, among others. This study applies NAA to quantitatively evaluate elemental concentrations in coffee samples and offers a comprehensive review of NAA —its operational principles and associated methodologies. Utilizing the TRIGA Mark II reactor at the Atominstitut in Vienna and using apple leaves powder samples as a standard reference, we meticulously prepared and irradiated the coffee samples for 180 seconds. The reactor has a power of 250 kW and a maximum thermal neutron flux density of $1 \times 10^{13} \text{cm}^{-2}\text{s}^{-1}$. The samples are fixed in predetermined locations in the reactor core using a pneumatic transport system. Following irradiation, a High Purity Germanium (HPGe) detector was employed to measure the samples. Spectral analysis and comparison of elemental activity enabled the calculation of elemental concentrations. The radionuclides identified are Na, Ca, K, Cl and Mn with masses for each at 1.28 μg , 73 μg , 1349 μg , 10.13 μg and 2.07 μg , respectively. The findings reiterate the effectiveness of NAA in elemental composition quantification, with a spotlight on coffee samples, and underscore the study's contribution to consolidating knowledge around NAA.

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