

A Sensitive Method for the Determination of Uranium in Biological Samples Utilizing Kinetic Phosphorescence Analysis (KPA)

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Kinetic phosphorescence analysis is a technique that provides rapid, precise and accurate determination of uranium concentration in aqueous solutions. This technique utilizes a laser source to excite an aqueous solution of uranium, and measure the emission luminescence intensity over time to determine the luminescence decay profile. The lifetime of the luminescence decay profile and the linearity of the log luminescence intensity versus time profile are indications of the specificity of the technique for uranium determination. The luminescence intensity at the onset of decay (the initial luminescence intensity), which is the luminescence intensity at time zero after termination of the laser pulse used for excitation, is proportional to the uranium concentration in the sample. Calibration standards of known uranium concentrations are used to construct the calibration curve between the initial luminescence intensity and uranium concentration. This calibration curve is used to determine the uranium concentration of unknown samples from their initial luminescence intensity. We developed the sample preparation method that allows the determination of uranium concentrations in urine, plasma, kidney, liver, bone spleen and soft tissue sample. Tissue samples are subjected to dry-ashing in a muffle furnace at 600°C and wet-ashing with concentrated nitric acid and hydrogen peroxide twice to destroy the organic component in the sample that may interfere with uranium determination by KPA. Samples are then solubilized in 0.82 M nitric acid prior to analysis by KPA. The assay calibration curves are linear and cover the range of uranium concentrations between 0.05 $\mu\text{g l}^{-1}$ and 1000 $\mu\text{g l}^{-1}$ (0.05-1000 ppb). The developed sample preparation procedures coupled with the KPA technique provide a specific, sensitive, precise and accurate method for the determination of uranium concentration in tissue sample. This method was used to quantify uranium in different tissue sample obtained over a period of 90 days following a single intraperitoneal uranium dose of 0.1 mg kg^{-1} in rats.

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