Uranium Isotopes Bioassay in the Civilians of Baghdad and Al Basra after Operation Iraqi Freedom*

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The purpose of this study was to determine the concentration and precise isotopic ratios of four uranium isotopes in the urine specimens of civilians of Baghdad and Basra following Operation Iraqi Freedom.

The study included fifteen symptomatic civilians, ten from the Baghdad area and five from the Al Basra, Abu Khasib area, exposed to aerial bombings and/or tank battles. The subjects' most common symptoms included fatigue, intermittent fever, respiratory impairment, nocturnal diaphoresis, headaches, musculoskeletal pains, urinary tract impairment, and affect disorders. Urine samples were collected by the Uranium Medical Research Centre field team. The urine specimens were analyzed at the Institute for Mineralogy, JW Goethe University, Frankfurt am Main, Germany, using double-focusing Thermo Finnigan Neptune multi-collector ICP-MS equipped with a retarding potential quadrupole lens and a secondary electron multiplier for ion counting. The urine internal standard of natural isotopic composition and a certified isotope reference solution of uranium were also analyzed. Data errors were calculated with the consideration of uncertainty of all applied corrections and reproducibility of the reference solution. The analytical methodology included preconcentration of urine samples using co-precipitation, oxidation of organic matter, uranium purification by ion-exchange chromatography, and mass spectrometry analysis.

The mean concentration of total uranium in all samples was found to be 24.3 ± 4.6 ng/L. This is within normal limits for the international standard uranium concentration in urine. Eight samples from Baghdad and two from Basra had natural ^{238}U:^{235}U isotopic ratio of 138.2 ± 0.2. In contrast, two Baghdad and three Basra samples were compatible with depleted uranium (143.0 ± 1.8). The ^{234}U:^{238}U ratio was $7.00 \times 10^{-5} \pm 1.16 \times 10^{-6}$. The ^{236}U:^{238}U ratio (7.3×10^{-7}) indicates a significant presence of ^{236}U in 8/15 samples, which are higher concentrations than recently reported first-time findings of ^{236}U in natural uranium (10^{-10} to 10^{-14}).

Our results demonstrate the presence of depleted uranium in the civilians of Baghdad and Basra after Operation Iraqi Freedom. The cause of the urinary presence of depleted uranium may be consistent with our previously reported findings of DU contamination of the Allied Forces veterans in Gulf War I, by inhalation of DU containing aerosols.

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