LETTER TO THE EDITOR

A nuclear reactor: more than the producer of energy and radionuclides

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Dear editor,

Nuclear reactors are usually associated with the production of energy. However, some reactors provide radionuclides, now widely applied in clinical medicine and research. Both α and β emitters can be effective in the treatment of tumors and metastases, while γ-emission allows imaging of organs and activity of biological processes. A less well known application of a research reactor is instrumental neutron activation analysis (INAA), a technique for qualitative and quantitative multi-element analysis of major, rare and trace elements in all kinds of materials including human tissues, nails, hair and blood. The method is based on the bombardment of a sample with neutrons followed by capture of a neutron by the nucleus of an isotope of an element and subsequent conversion to a radioactive isotope.[1] The radioactive emission characteristics and decay paths of the various isotopes are well known and this way the presence and concentration of more than 50 elements can be measured. Using INAA it could recently be shown that in contrast to Dutch patients, the majority of Sudanese iron deficient patients also have zinc deficiency.[2] In contrast to other techniques, which measure on an atomic level, INAA is not restricted to measurement in small samples, it can even be used to analyse samples weighing several kilograms. This is especially of importance when an element is not distributed homogeneously in materials, as can be the case in food, but also in human tissues. INAA is now actively used in biomonitoring, the measurement of the body burden of toxic chemical compounds and elements in biological substances. Lichens in particular have proven useful in registering pollution in the proximity of industries, as well as in measuring elements transported by air masses over large distances.[3] A promising development is the use of enriched stable isotopes, an attractive alternative for the application of radioactive tracers in the study of the bioavailability and distribution of essential trace elements and metals in the human body. The enriched stable isotope Fe^{58} has been used, for example, to study iron metabolism in vivo in patients with iron deficiency and hemochromatosis, avoiding the radioactive side effect of the formerly used Fe^{59} isotope.[4] Since the number of research reactors is limited, access to its facilities can be problematic. However, with the focus of the reactor of the TU Delft on health and environment, clinical investigators are encouraged to explore its potentials.

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