NUCLEAR-BASED METHODS FOR THE ANALYSIS OF TRACE ELEMENT POLLUTANTS IN HUMAN HAIR+

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The trace element composition of human hair is a suitable indicator of exposure to trace element pollutants. During the implementation of an international research programme, coordinated by the IAEA, on the use of nuclear methods for detecting trace element pollutants in hair, much valuable information was collected both on normal levels of trace elements and on increased levels caused by pollution. As a result of reviewing and comparing the data, interesting observations relating to the spread of concentrations were made. Standardized procedures were elaborated for a number of analytical techniques as well as for pre-analytical preparations in the analysis of hair.

Introduction

Since 1975 the Agency has been engaged in applications of nuclear methods for the analysis of trace element pollutants. One of the reasons for this is that nuclear and nuclear-related techniques are effective tools in the research on or monitoring of environmental pollution, but their potential is still not sufficiently utilized.

Since 1977 we have had a special subprogramme “Health-related Environmental Research”. Its component, “Nuclear Methods in Environmental Research” was actually started in 1975 and has as its kernel two successive projects: “Neutron Activation Analysis of Pollutants in Human Hair using Research Reactors” and “Accelerator-based Techniques for the Analysis of Pollutants in Human Hair”, implemented under a coordinated research programme: “Nuclear-based Methods for the Analysis of Pollutants in Human Hair” and aiming at establishing patterns for the trace element composition of human hair for normal populations in different geographical and economical regions and revealing groups or even individuals with increased levels of trace element pollutants.

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Why did we choose hair as the object in our projects? At low exposures to trace element pollutants their concentrations in hair averaged along its length, reflect the total of internal and external contamination. Hence, any increased concentrations in some groups or individuals would indicate an increased exposure, which does not necessarily result in internal contamination but implies a certain risk. It is possible to distinguish between the internal and external components of contamination, but these more detailed investigations may be confined to the specified groups or individuals with increased levels.

At significant levels of internal contamination, the composition of human hair along its length reflects the history of contamination, including that from a sudden exposure.

Up to now, about 50 scientists from more than 20 countries have contributed to the implementation of the projects. An advisory group meeting held in March 1976 produced a report containing recommendations on the general methodology in applying nuclear methods for research and monitoring of trace element pollutants as well as on particular matters such as neutron activation analysis of trace elements in human hair, with emphasis on standardized procedures. The use of hair as an indicator of internal and external contamination of man by trace element pollutants was further discussed at a consultants' meeting in September 1977. Another advisory group meeting in January 1978 accentuated the use of accelerator-based techniques for the analysis of trace pollutants in man and particularly of photon activation analysis and proton induced X-ray analysis of hair. A review "Activation Analysis of Hair as an Indicator of Contamination of Man by Environmental Trace Element Pollutants" was produced by the IAEA.1

Special attention has been given to standardization and harmonization of pre-analytical and analytical procedures. Such standardization and harmonization is a necessary condition for comparing results obtained in different countries and with different techniques.

Methodology of the trace element analysis of hair as specified for normal conditions

Sampling of hair

"Normal" usually means such living conditions of man under which there are no reasons for suspecting either pollution by a given trace element, due to natural or man-made factors, or its deficiency which could noticeably affect human health. The inadequacy of this definition is evident. Therefore, ascribing a particular group of persons to "normal" may not be regarded as a final judgement, for this can change in the light of new facts.