

Radioisotope Production and Radiation Technology

Objective

To strengthen national capabilities to produce radioisotope products and radiopharmaceuticals and to apply radiation technology, thus contributing to improved health care and safe, clean industrial development in Member States.

The possible shortage of molybdenum-99 (^{99}Mo), the radioactive parent of the most widely used radioisotope in nuclear medicine, technetium-99m ($^{99\text{m}}\text{Tc}$), is still a major concern in Member States. A coordinated research project (CRP) involving 13 institutions from 10 Member States, aimed at addressing this issue, was completed in 2015. The project, entitled 'Accelerator-based Alternatives to Non-HEU Production of $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ ', studied different aspects of cyclotron based $^{99\text{m}}\text{Tc}$ production, such as the preparation of targets, irradiation of targets under high beam currents, target processing, target recovery and quality control of the final product. The project demonstrated an alternative technology for producing $^{99\text{m}}\text{Tc}$ that is in the process of obtaining regulatory approval.

The Agency also completed a CRP on the development and preclinical evaluation of therapeutic radiopharmaceuticals based on monoclonal antibodies and peptides labelled with lutetium-177 (^{177}Lu) and yttrium-90 (^{90}Y) (Fig. 1). The project was aimed at promoting the production and quality control of new radiopharmaceuticals for targeted therapy based on radioimmunotherapy and peptide receptor based radionuclide therapy. As a result of this CRP, many laboratories in participating Member States are now able to develop suitable ^{177}Lu or ^{90}Y radiopharmaceuticals for radioimmunotherapy.

The Agency continued to support African Member States in addressing the significant shortage of qualified radiopharmacy professionals in the region. During the year, it finalized e-learning syllabi and workshop materials for a master of science degree in radiopharmacy and a postgraduate diploma course. It also facilitated the enrolment of three students from Africa – two from Kenya and one from Ethiopia – in a master of science programme in radiopharmacy in the former Yugoslav Republic of Macedonia.

In December, the Agency held a Technical Meeting on Regulatory Aspects of Radiopharmaceutical Production aimed at supporting national radiopharmaceutical regulators. The meeting was attended by 11 participants from 10 Member States, who highlighted the need for education, training and harmonization of regulations in the field. The meeting provided a unique opportunity for participants to share their experience, and to discuss national regulations and challenges.

Radiation Technology Applications

Radiation processing technologies are used in a number of green production processes in both developed and developing countries. The Agency supports Member States in using

“The possible shortage of molybdenum-99 (^{99}Mo), the radioactive parent of the most widely used radioisotope in nuclear medicine, technetium-99m ($^{99\text{m}}\text{Tc}$), is still a major concern in Member States.”

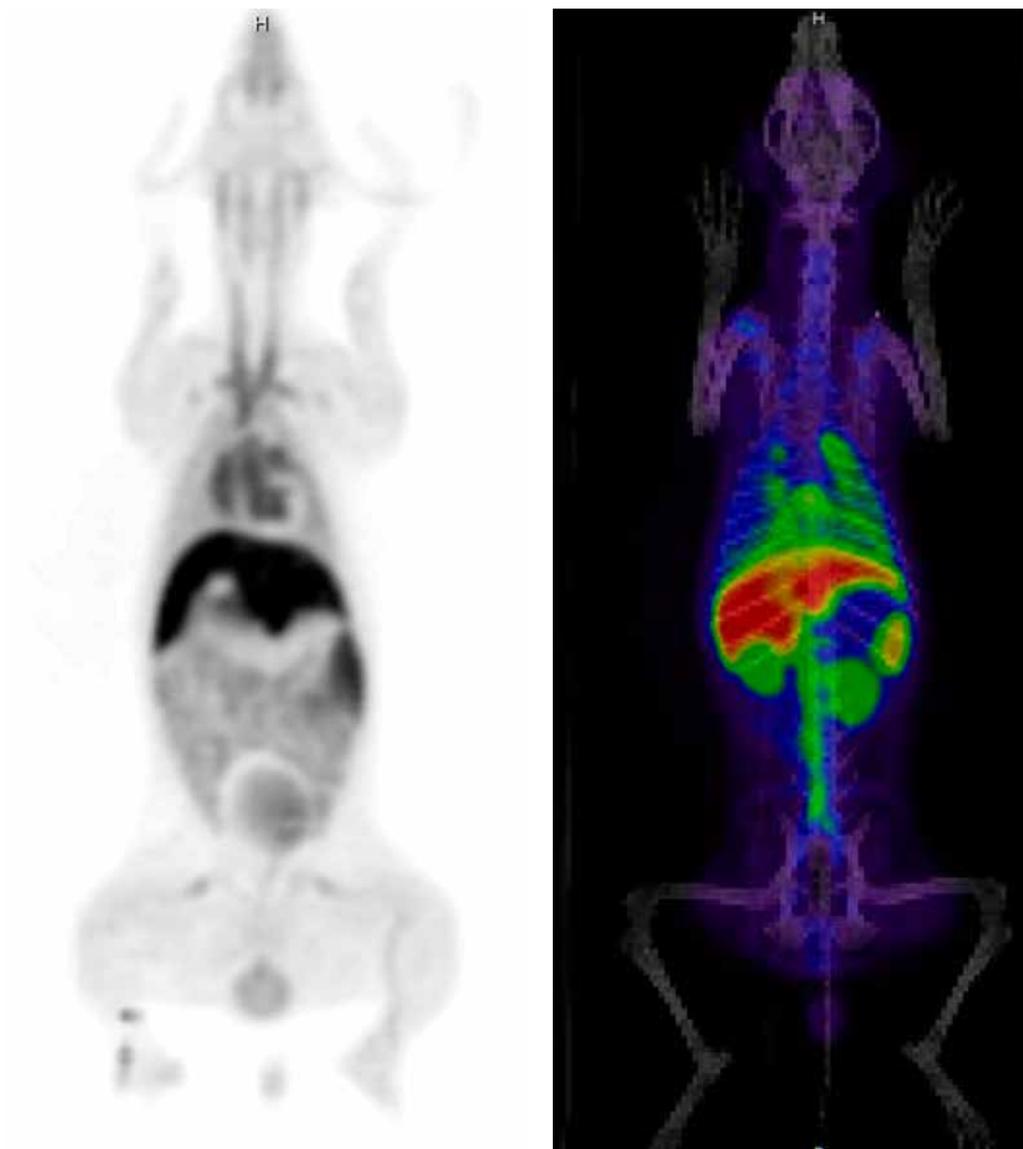


FIG. 1. Whole body imaging of a healthy beagle 24 hours after application of ^{177}Lu -Rituximab, one of the ^{177}Lu labelled monoclonal antibodies developed and evaluated as part of an Agency coordinated research project.

these technologies for a wide range of applications, from sterilization of single-use medical products to development of advanced materials for applications in medicine, agriculture and environmental remediation. Further expansion of their use depends on the availability of appropriately qualified personnel in research and development and in irradiation facilities, and on decision makers and end users being made aware of the potential of these technologies. In this context, a Technical Meeting on Enhancing Education Programmes for the Radiation Sciences in Cooperation with IAEA Collaborating Centres was organized in 2015 with representatives of universities, research organizations and Agency Collaborating Centres. The meeting drew 20 participants from 18 Member States, who identified needs and gaps in educational programmes and in access to radiation facilities, and suggested ways to address these issues. Participants also highlighted the important contributions of the Agency and its Collaborating Centres in this area.

The 2015 IAEA Scientific Forum, entitled Atoms in Industry: Radiation Technology for Development, brought together leading experts, academics and industrial representatives. Held at the Agency's General Conference in September, the Forum included presentations showcasing the important role that radiation technologies play in improving the quality of

products used in daily life. A panel discussion considered possible future developments and offered Member State representatives the opportunity to share their experience and their plans in the area of radiation technology. The Forum contributed to a better understanding of the role radiation technology plays in improving industrial products and processes in an environmentally sound way, and the ways it benefits both developed and developing countries.

Composite materials combine the properties of individual components to produce new materials used in a range of applications — from parts for the automotive and aerospace industries to food packaging materials and artificial organs. Materials reinforced with nanoscale components are adding new dimensions to composite materials and enabling major improvements in functional and structural properties. In 2015, the Agency completed a CRP on the use of radiation techniques to address Member State needs for advanced composite materials. Participating institutions developed methodologies and protocols for new abrasion resistant coating formulations, radiation curable nanocomposites from natural polymers, biodegradable packaging materials suitable for radiation sterilization, and methods for modifying surface characteristics of nanosized materials to enhance polymer filler interaction.

The fourth and final Research Coordination Meeting to review the results of a CRP on radiation treatment of wastewater for reuse, with a particular focus on wastewater containing organic pollutants, was held in 2015 at Tsinghua University in China. The CRP investigated how radiation treatment can be applied to address a wide variety of challenging pollutants in industrial and municipal wastewater and in wastewater originating from the pharmaceutical, textile, plastic and chemical industries. The CRP demonstrated that the use of radiation technology to treat organic contaminants in wastewater is economically competitive with other technologies, especially for pollutants that are currently problematic for industrial and municipal wastewater. The CRP also provided opportunities for training in various aspects of irradiation technology and resulted in a number of scientific publications as well as four patents.

Management and conservation of natural resources is key to sustainable development. Nucleonic analysis and control systems, radiotracing technologies, and other relevant nuclear technologies have an important role to play in the optimization of resource based industries such as the mining, mineral and metallurgical industries. To support Member State use of nuclear technologies in these areas, the Agency launched a new CRP in 2015 entitled 'Development of Radiometric Methods for Exploration and Process Optimization in Mining and Mineral Industries'. The first meeting was held in December with 21 participants from 19 Member States.

“a CRP on radiation treatment of wastewater for reuse....demonstrated that the use of radiation technology to treat organic contaminants in wastewater is economically competitive with other technologies.”
