2017/1/13

IAEA 動態報告
2017/1/02- 1/13

MYANMAR'S DAIRY FARMERS BENEFIT FROM CATTLE BREEDING PROGRAMME USING NUCLEAR-BASED TECHNIQUES

緬甸農民利用核技術從牛育種計劃中獲益

Lay Htaung Kan Village, Myanmar – Small scale dairy farmer Zaw Oo from this village in southern Myanmar may seem an unlikely beneficiary of nuclear science. But an isotopic technique used to breed more productive dairy cows at lower costs has enabled him to escape poverty and build a better future for his three children.

報告摘要(KEY INFORMATION)

1. 來自緬甸南部村莊的小規模酪農，利用同位素技術以更低的成本繁殖更多的乳牛，成為核子科學的受益者。
2. 一份基於原子能總署支持所發表的期刊發現另一種生產鉬-99（Mo-99）的方法，此方法可以幫助增加全世界醫療保健的這種關鍵同位素之供應。
3. 上個月發布的分離雄性和雌性蚊子的開創性方法，使用了核技術控制諸如登革熱等疾病的昆蟲傳播。
4. 自 2009 年以來，在原子能總署支持下所開展的研究表明，核技術有助於泰國幫助科學家確定提高兒童營養水平的最佳方法來打擊營養不良。
5. 2016 年 12 月 5 日至 9 日，總署在牙買加金斯頓舉辦了一個計劃設計區域講習班，旨在幫助加勒比國家，包括面臨共同挑戰的新會員國，制訂高質量和注重成果的技術合作項目。
6. 2016 年 12 月 6 - 9 日，國家能源局和法國放射性廢物管理機構在法國巴黎舉行了第五屆國際地質資料庫會議（ICGR）。強調了國際合作對安全實施地質處置項目的附加價值。
7. 日前出版的 2016 年“國際評估危機臨界安全基準實驗手冊”包含從世界各地各種關鍵設施進行的實驗中得出的臨界安全基準規範。

His life changed in 2014, thanks to Oo's participation in an artificial insemination scheme, sponsored by the local dairy company that buys his milk. Switching to the use of artificial semen to fertilize his cows has allowed Oo to sell his bulls and save 600,000 kyat (US $500) a month in fodder costs as a result. It has also freed up space in his tiny farmstead for more cows. Having invested his savings in additional cows, Oo has moved from subsistence farming to building a small business.

"I have no expertise in any other line of business than dairy farming," he said. "Thanks to this improvement, I can now build a future for my family."

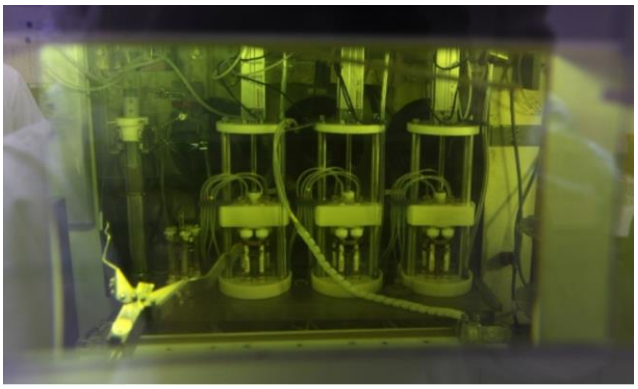
Read more here on how nuclear and isotopic techniques contribute to the production of high quality semen worldwide, including in many developing countries. Nuclear and nuclear derived technologies have also been used to detect viruses like foot and mouth disease, and the IAEA, the FAO and their partners have helped Myanmar's veterinary laboratory buy materials and acquire expertise (see Fighting foot and mouth disease using nuclear techniques).

Cows borne through artificial insemination with the semen of superior breeds produce more milk and better calves, yielding further benefits, said Tin Win, owner of the Silvery Pearl Dairy, the local company that buys Oo's milk. Silvery Pearl switched to artificial insemination of its own cows back in 2008, and has seen yields increase from around 6.5 litres of milk per cow per day to close to nine litres.

Improving native cattle breeds through genetic selection in such a way that they produce more milk but still retain their adaptability to the local environment and their tolerance to local diseases is crucial in sustainably increasing their productivity. Various nuclear and nuclear-derived technologies exist to support such genetic selection procedures. The IAEA and the Food and Agriculture Organization of the United Nations (FAO) have jointly supported Myanmar's Livestock Breeding and Veterinary Department in perfecting and rolling out these techniques across the country.

NEW PAPER REVIEWS ALTERNATIVE TECHNOLOGY TO BOOST PRODUCTION OF MO-99

新論文評論替代技術促進 Mo-99 的生產



An alternative method for producing molybdenum-99 (Mo-99) could help increase the supply of this key isotope used to provide essential healthcare to millions of patients worldwide, revealed a recent paper, based on IAEA-supported research and co-authored by an IAEA expert.

As major research reactors supplying Mo-99 are aging and ceasing production, the alternative method discussed in the paper offers a simplified way to diversify production and help ensure continued Mo-99 supplies for uninterrupted nuclear medicine services.

Troubles in the past

In 2009, reactors producing Mo-99 in Canada and the Netherlands were temporarily shut down for necessary repairs and maintenance. This caused a major disruption in healthcare services worldwide, leading to cancelled medical scans, postponed operations and, in some cases, required reverting back to old, less effective techniques. While supply conditions have since improved, health officials and scientists have been looking into alternatives to address what a recent U.S. National Academies report called “supply vulnerabilities”.

“This disruption was really a wake-up call that something needed to be changed in how we are producing Mo-99,” said Danas Ridikas, Research Reactor Specialist at the IAEA and a co-author of the paper. “Diversification of how and where Mo-99 is produced, increasing efficiencies in the way the isotope is used, and devising a business model to recover production costs have become essential to ensure a continued, stable and economically viable supply of Mo-99.”

Mo-99 is the parent isotope of technetium-99m (Tc-99m), the most widely used radionuclide for medical imaging. Because Tc-99m is unstable and decays quickly, its more stable parent isotope is produced and transported to hospitals.

With a research reactor in Canada ceasing production in October 2016, and another large producer in the Netherlands scheduled to go offline by 2024, finding alternative production methods are becoming more critical, Ridikas explained. Producing Mo-99 by irradiating natural or enriched molybdenum is one of the lesser-used yet viable alternatives to fulfil domestic needs, in particular for countries with research reactor facilities, he said.

Irradiating molybdenum

This technique, already in use in Chile, India, Kazakhstan, Peru, Russian and Uzbekistan, involves a simpler production process and generates less radioactive waste than the traditional method of producing Mo-99 through fission from uranium. In addition, it can improve the utilization of research reactors. Several countries, including Jordan, Mexico and Morocco, are considering implementation of the technique.

While the new method shows potential, experts are still evaluating its efficiency. In December 2015, an IAEA workshop on the subject brought together experts from 15 research reactor facilities in 12 countries to explore the method and its feasibility. Experiments to irradiate natural molybdenum targets, carried out in several research reactors with IAEA support, clearly showed that the Mo-99 obtained through irradiation produced less Mo-99 per gram of material irradiated than the fission method. However, the amount obtained should still be sufficient to meet local needs in several countries.

Irradiating enriched molybdenum would yield a higher ratio of Mo-99, but would require a more expensive raw material. Therefore, using natural molybdenum despite the lower yield may be more optimal, Ridikas said. “The cost-effectiveness of irradiation and processing, compared to the fission method, still needs to be determined.”

The lessons learned from the workshop and data on the approximate production capacities of the reactors formed the basis for the paper by Ridikas and several other scientists published recently in the Journal of Radioanalytical and Nuclear Chemistry. It also serves as a platform for continued research. A related workshop on irradiated target processing and preparation of Tc-99m generators, based on Mo-99 production by neutron capture, will be organized by the IAEA in 2017 in Kazakhstan.

NEW METHOD ADVANCES RESEARCH ON CONTROLLING MOSQUITOES USING NUCLEAR TECHNIQUES

新型方法使用核技術提升對控制蚊子的研究

A pioneering method unveiled last month to separate male and female mosquitoes could be a major step towards using the nuclear-based sterile insect technique (SIT) to control the insects that transmit diseases such as Zika, dengue and chikunguya.

SIT involves using ionizing radiation to sterilize mass-reared insects of the target pest and then releasing them into nature where they mate with wild insects, resulting in no offspring and, over time, reducing the overall insect population. SIT has been employed successfully in over 40 countries against agricultural pests such as various fruit flies, tsetse flies, screwworm and moths pests, and research for its application against the Aedes mosquitoes has intensified in the wake of the Zika crisis last year. The IAEA, in partnership with the Food and Agriculture Organization of the United Nations (FAO), is spearheading global research in the development and application of SIT, including against the Aedes mosquitoes.

The main challenge facing researchers in scaling up the use of SIT against various species of mosquitoes has been the lack of a reliable method to remove females from among the mosquitoes that are released. Eliminating females before release is crucial to the use of SIT against mosquitoes, because it is the bites by female mosquitoes that transfer diseases.

In countries where the use of SIT against Aedes mosquitoes is being tested or planned, such as Brazil, China and Mexico, a manual method is used to separate males from females. Female pupae – the stage in the life of insect between the larvae and the adult stage – are larger than male pupae, offering a way to distinguish and remove females before release. However, this method is very labour-intensive and is therefore not practical for up-scaling to the tens of millions of mosquitoes that would be required in order to use SIT at a larger scale to protect cities from disease transmission, said Rui Cardoso-Pereira, an SIT expert at the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

Finding alternative methods for what insiders called “sexing” of mosquitoes is the focus of an ongoing five-year coordinated research project under the auspices of the Joint FAO/IAEA Division, with the participation of experts from 13 countries.

No optical illusion

Researchers at TRAGSA, the Spanish government’s institution focusing on environmental sciences and services, have now built the prototype of a device capable of differentiating male and female mosquitoes via artificial vision and then eliminating the females with the use of laser beams. The device consists of a rotating disk to distribute the mass-reared pupae, which are than analysed using software that can distinguish the sexes based on size,

explained Ignacio Plá Mora of TRAGSA's Pest Control Department.

The preliminary results of the tests conducted have shown that 99.7% of the females were eliminated, while up to 80% of the males survived and could be released, Plá Mora said. "The results achieved are highly satisfactory compared to those obtained by the manual methods that are currently used," he said.

While the prototype can process a million Aedes males a day, it still does not quite scale up to the level of industrial production required at a regional scale, it will be satisfactory for projects targeting individual towns or villages, particularly in countries where the labour costs associated with manual sorting of mosquito pupae is prohibitive, Cardoso-Pereira said. Further research is ongoing to perfect the method in order to eliminate fewer males and to further upscale it.

TRAGSA's participation in the coordinated research project has helped them in the development of the new method. "When top experts in an area work together, everyone's research accelerates," Cardoso-Pereira said.

THAI SCIENTISTS USE NUCLEAR TECHNOLOGY TO FIGHT THE DOUBLE BURDEN OF MALNUTRITION

泰國科學家使用核技術來戰勝營養不良的雙重負擔

Nuclear techniques contribute to Thailand's fight against malnutrition by helping scientists identify best ways to increase nutrient levels in children. Studies carried out since 2009 with the support of the IAEA have shown that food fortified with vitamins and minerals, such as iron, zinc, vitamin A and calcium, enhance micronutrient intake and increase nutrient levels in children.

"There was a micronutrient gap in the diets of these young children, a gap that most local foods cannot meet," said Emorn Udomkesmalee, Senior Advisor and Former Director of the Institute of Nutrition, Mahidol University (INMU) near Bangkok. "By using isotopic techniques, we found a way to identify this gap and to measure

how their bodies absorb and use certain micronutrients."

Children need more micronutrients for their growth than provided in a typical diet, which contains sufficient calories, but often not enough iron, zinc, vitamin A or calcium. In many developing countries, low nutrient- density food such as plants is a main part of the diet. This can result in micronutrient deficiencies — often referred to as 'hidden hunger' — that can affect hundreds of thousands of children, Udomkesmalee said. According to a 2012 survey, approximately 800 000 children under five suffered from undernutrition in Thailand, putting them at risk of micronutrient deficiencies.

" If children don't consume enough micronutrients, they do not grow properly and can become vulnerable to infectious diseases," said Christine Slater, nutrition specialist at the IAEA. Over the past two decades, Thailand has actively worked to reduce malnutrition and nutrient deficiencies through health policies and community-based nutrition programmes.

One way to prevent and control micronutrient deficiencies is to distribute food fortified with vitamins and minerals — now a common practice in Thailand. Fortified food is made by adding micronutrients to commonly consumed food, such as oil or cereals, or by biofortification, the process of growing crops with increased levels of these essential micronutrients. This fortified food is typically added as a complement to a normal diet.

Between 2009 and 2012, Thai scientists trained by the IAEA tested a food fortification programme in children between six and 24 months old. They gave a group of children rice fortified with iron, zinc and vitamin A. After measuring their micronutrient reserves using isotopic techniques (see The Science box), they found that children who consumed the fortified rice had a significant increase in iron, zinc and vitamin A reserves, in contrast to the control group. They used a computer simulation to further confirm the suitability of the fortified rice for meeting nutrient requirements.

Before the introduction of isotopic techniques, scientists in Thailand had to rely on calculations based on select, high-nutrient food to verify whether the country's nutrition programmes were working, said Pattanee Winichagoon, Associate Professor at INMU. "Assessment was based on our knowledge and calculations and did not adequately consider elements such as the body's absorption of the micronutrients," she said.

Turning data into practice

The results of these studies are now under consideration to help further optimize nutrition intervention programmes across the country.

" We have been communicating with the Ministry of Public Health and the Paediatric Nutrition Group and already started discussions on how to make use of our analyses," Winichagoon said. If the study results are taken on board, they will lead to new pragmatic feeding guidelines on complementary foods for infants and young children, she added.

Learn today, teach tomorrow

The IAEA has been working with Thailand in the area of nutrition since 1998. The country has benefited from the IAEA's technical cooperation programme and coordinated research projects in the form of training courses, scientific visits, fellowships and equipment. Thai scientists have also been working with the IAEA to use isotopic techniques to assess exclusive breast-feeding of infants from birth to six months, and to ensure iron-fortified food is not detrimental for people with iron or other nutrient deficiencies.

Hosting courses for others to learn about isotopic techniques is a way to pay these efforts back, Winichagoon said. "It would be a shame not to share the know-how. We have so many questions, and we're not the only ones."

Nutrition is a topic of interest for Thailand and for the world, Slater said. "Improved nutrition has great consequences for society. A well-nourished child will have the adequate capacity to study when he or she grows older and will be able to earn a living as an adult. Overall, a well-nourished population helps the country develop."

THE SCIENCE

Isotopic techniques and nutrition in children

Isotopes are atoms of the same element that have the same number of protons but different numbers of neutrons. Isotopic techniques track how the body takes in, uses and retains nutrients present in food that are vital to supporting healthy growth and development. Scientists use these techniques to determine bioavailability, which is the fraction of a nutrient our body absorbs and uses for growth and metabolism.

For example, to check iron or zinc absorption, patients eat test meals mixed with stable isotopes. Measurements of blood or urine samples taken later reveal how much of the isotopes have been incorporated into the body. These measurements are analysed through mass spectrometry, a method that uses a sensitive detector to selectively identify and measure various compounds.

To assess vitamin A status, patients take a dose of carbon-13 or deuterium-labelled vitamin A. Experts use a mass spectrometer to analyse blood samples taken before and after the dose of vitamin A. Based on the dilution of the precisely measured dose of isotope-labelled vitamin A, it is possible to calculate the total quantity of exchangeable vitamin A in the body.

BETTER PLANNING, BETTER PROJECTS: REGIONAL WORKSHOP ON PROJECT DESIGN TAKES PLACE IN JAMAICA

更好的規劃，更好的計畫：牙買加計劃設計地區研討會

A regional workshop on project design using the Logical Framework Approach has been held in Kingston, Jamaica, from 5 to 9 December 2016. The workshop supported the design of projects intended for proposal as part of the IAEA's 2018-2019 technical cooperation (TC) programme cycle, and specifically aimed to help Caribbean countries, including new Member States that face common challenges such as Small Island Development States (SIDS), to develop high-quality and results-oriented technical cooperation projects.

The project design workshop was organized in collaboration with the Planning Institute of Jamaica. Six participants from Antigua and Barbuda, Barbados, the Bahamas, Dominica, Haiti, and Trinidad and Tobago attended the workshop, together with Jamaican counterparts and the IAEA team. The workshop combined both practical and theoretical training sessions. The concept of the Logical Framework Approach (LFA), used in TC project design, implementation, monitoring, and evaluation, was introduced. Participants were coached in how to apply the approach in designing their new projects by Ms Galya Dimitrova, TC Training Officer, Mr Saul Perez, Section Head of TC Latin America and the Caribbean Region, and Ms Scarlett Ihlau, Programme Management Officer for the attending Member States.

Participants from newer IAEA Member States gained a valuable insight into the way Jamaica, an IAEA Member State since 1965, is developing its national TC projects for the upcoming 2018-2019 TC cycle. They also had an opportunity to visit the Jamaican counterpart institutions that are involved in the design of the new projects, which focus on human health, food and agriculture, water and the environment, as well as on safety and security.

The workshop was attended by high-level representatives from Jamaican stakeholder institutions, including Professor Minerva Thame, representing the Medical Science Faculty of the University of the West Indies, Dr Dutris Borne, Regional Technical Director from the South East Regional Health Authority, and Mr Stephen Wedderburn, Chief Technical Director in the Ministry of Industry, Commerce, Agriculture and Fisheries.

DEVELOPING AND IMPLEMENTING GEOLOGICAL REPOSITORIES FOR LONG-LIVED RADIOACTIVE WASTE

開發和實施長壽命放射性廢物的地質處置庫

On 6-9 December 2016, the NEA and the French national radioactive waste management agency Andra held the fifth International Conference on Geological Repositories (ICGR) in Paris, France. The conference, on "Continued Engagement and Safe Implementation of Geological Repositories", convened senior-level decision-makers representing international and national bodies from countries that are in different stages of implementing deep geological repository programmes. Participants underlined the added value of international co-operation for the safe implementation of geological repository projects and concluded that deep geological repositories remain a viable and safe option for the management of radioactive waste. The scientific knowledge and technical bases relating to the disposal of radioactive waste are being enhanced and the technical design of repositories will be further optimised through current and future R&D programmes. Participants also noted that current strategies for repository implementation follow international standards, recommendations and best practices for nuclear safety and security. The important role of continued stakeholder dialogue in advancing a geological repository project was also highlighted. Conference proceedings are in preparation and will be issued online.

INTERNATIONAL CRITICALITY SAFETY BENCHMARK EVALUATION

國際臨界安全基準評估

The 2016 edition of the International Handbook of Evaluated Criticality Safety Benchmark Experiments contains criticality safety benchmark specifications that have been derived from experiments performed at various critical facilities around the world. It presents evaluated criticality safety benchmark data in nine volumes that span over 70 000 pages. The handbook contains 567 evaluations with benchmark specifications for 4 913 critical, near-critical or subcritical configurations, 45 criticality alarm placement/shielding configurations with multiple dose points for each, and 215 configurations that have been categorised as fundamental physics measurements that are relevant to criticality safety applications. Requests to obtain the DVD or online access should be made by completing the online Handbook Request Form at oe.cd/1f8