Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Animal Production & Health Newsletter

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To Our Readers

Grazing on improved pasture yields good fertility in cattle.

Dear Colleagues,

At this half-point stage of the year, it is a pleasure to report back to you on our activities and initiatives. Apart from our regular Coordinated Research Project (CRP) activities and our technical support given to national and regional technical cooperation projects (TC), we were also involved in the early and effective diagnoses and control of emerging and re-emerging transboundary animal and zoonotic diseases such as lumpy skin disease in Eastern Europe and highly pathogenic avian influenza H5N1 in Western Africa. In addition, and in close collaboration with many of you, we were involved in the technical planning of the new TC projects by Member States (MS) for the 2018/2019 biennial project cycle, and, the preparation of the IAEA's 2018/2019 work and budget programme.

Please look at our website and our Animal Production and Health Newsletter to get familiarized with all the activities of the Section.

As is customary, I want to highlight some of our activities, and in this newsletter I want to mention our exciting CRPs that focus on:

- **Enhanced use of stable isotopes to trace and monitor Transboundary Animal Diseases (TADs).** Wild migratory birds may carry animal and zoonotic pathogens and transmit them throughout their migration routes. In order to determine their importance in disease transmission, it is essential to develop tools for detecting their carrier status and to understand their natural migration routes. Technologies which enable determination of these parameters

without capturing the birds have clear advantages, as they do not interfere with the natural life cycle and offer large scale sampling, covering significant portions of a population. In order to increase the resolution of assignments and to trace short range migratory animals, it is important to complement the stable isotopes (SI) analysis with other substances, such as heavy metals, insecticides and pesticides. The final objective of the CRP is to promote the use of similar diagnostic platforms for monitoring of transboundary livestock and zoonotic diseases, and validate these technologies for use in large scale surveillance programmes with up to date diagnostic systems.

- **Irradiation of transboundary animal disease pathogens as vaccines and immune inducers.** Vaccines are essential tools in disease control. The increased apparition of resistance to many drugs used in the control of bacterial and parasitic diseases place vaccines in the fore front of disease control. Traditionally, there are two types of vaccines: live vaccines where pathogens have been attenuated by serial passages *in vitro* or *in vivo*, and killed vaccines where pathogens have been destroyed chemically while keeping their antigenic properties active. Usually, live vaccines are more efficient since they mimic natural infections and appropriately trigger the complete immune system. Unfortunately, some vaccines still have risks in particular the risk of reversion to pathogenicity. Such risks don't exist with killed vaccines but usually those are less efficient since the chemical inactivation process may destroy some antigens that are important in immune protection. Recent studies have demonstrated the usefulness of irradiation to inactivate pathogens in such a way that they are not able to grow but still have the ability to synthesize proteins and thereby to better trigger, *in vivo,* the entire repertoire of the host immune system. This CRP aims to develop protocols for the attenuation of pathogens by irradiation for their use as vaccines – i.e. biologically active but unable to replicate as vaccine candidates.

- **Veterinary diagnostic laboratory network (VETLAB Network) to prevent and control Transboundary animal diseases.** The VETLAB Network CRP provides an animal health diagnostic and control platform for the exchange of knowledge and expertise, as well as to improve the transfer of technologies and communication. This network is a communication tool for guidance and support to veterinary authorities, designated laboratories and field services on how to collect, analyse and manage information on transboundary animal diseases from the field. The VETLAB Network includes information on animal production and health entities throughout the world, their status (reference and designated laboratories, authorities and field services), the relevant standard operation procedures (SOPs) (for disease detection, reproduction etc.), as well as a guidance for response to animal disease challenges. Additionally, the network should enable information exchange in events requiring multi sectorial responses (natural disasters, nuclear accidents) and will be compatible for data synchronization / exchange with other relevant information resources, such as OIE WAHID, FAO EMPRES and WHO.

- **The development of effective diagnostic and vaccination strategies to control African swine fever will utilize nuclear and related diagnostic and vaccination technologies.** This includes the development, evaluation and validation of diagnostic technologies and platforms for the rapid and confirmatory detection of African swine fever for field or laboratory applications to allow for a quick implementation of quarantine measures. Additionally, prophylactic procedures and experimental vaccines are being investigated. This includes irradiating the virus to inhibit the strong immune modulatory activities and analysing the immune response of domestic and wild pigs after application. Results gained in this way should allow for a concise and focused approach for developing a vaccine. As African swine fever (ASF) viruses will be isolated from the participating laboratories, the genetic code will be analysed and published to support the international research community with up to date information and to allow the mapping of the different genotypes and strains.

- **Nuclear and related techniques to develop a practical method to predict pasture intake of ruminants grazing heterogeneous pastures and rangeland using stable isotopes and thus provide tools for better grassland management enhanced animal productivity.** Research outputs will help reduce the impact on the environment due to overgrazing and will allow the design of effective feed supplementation strategies at the farm level to optimize animal production and further the development of nuclear and related techniques for analysing animal feeds and forages to improve feed conversion into meat, milk and other valued products which will strengthen the research capacity among animal scientists. The CRP involves three major laboratory activities: analysis of concentrations of stable carbon isotope composition ($\delta^{13}C$) of n-alkanes in the plant and faecal samples to predict dry matter (DM) intake and its plant proportions; the use of conventional chemical analysis of plants to determine their nutritional value; and the development of the near infrared reflectance spectroscopy (NIRS) predictive equations of DM intake and the plant profile of that intake to facilitate the design of diets and supplements

required to cover the nutritional needs of animals to optimise their productivity.

- **Application of nuclear and genomic tools to enable for the selection of animals with enhanced productivity traits.** Lack of quality breeding males from local breeds is a major constraint for increasing livestock productivity in smallholder systems. Critical is the absence of infrastructure for performance recording and efficient progeny testing schemes to meet the demands for genetically superior breeding bulls. The project aims at applying nuclear and nuclear-derived molecular techniques to address two major issues prevailing in developing countries, which are directly associated with food security and livelihood improvement. Firstly, it will generate genomic data of performance recorded animals, which will enable breeder and farmers to related production traits with parentage and genetic admixture of animals leading to identification and selection of superior sires for breeding using artificial insemination. Secondly, ^{60}Co will be applied to develop a radiation hybrid panel of camel and use that for whole genome sequencing and identification of DNA markers for camel breeding. With the expected reduction in genotyping costs in the future, this technology will help meet the demand for genetically superior animals in developing countries.

Looking back at the activities of the past six months, we had several emergency actions and consultations (e.g. support to MS to address the Zika virus outbreaks in Latin America and the lumpy skin disease outbreaks in Eastern Europe), workshops, training courses, RCMs and consultants meetings. Activities scheduled for the next half-year include project review meetings, RCMs, inter-regional training courses and regional workshops. Both past and future activities are discussed in further detail in this newsletter and are also accessible at our website. Let us know if you have any ideas, comments, concerns or questions. Please feel free to contact us at any time.

Concerning news from the Section, we want to welcome Giovanni Cattoli as Head of the Animal Production and Health Laboratory at Seibersdorf. He is a virologist and joined the Section in February 2016. Giovanni obtained his degree in veterinary medicine and PhD from the University of Bologna (Italy) and spent three years as a post-doc at the University of Utrecht and the Free University of Amsterdam (NL). Before joining the IAEA, he worked as the Director of the Research & Innovation Department/OIE-FAO Reference Laboratory for animal influenza and Newcastle disease/FAO Reference Centre for Rabies in the National Veterinary Institute of Padova, Italy (IZSVe). We hope that Giovanni will have a pleasant and productive time with the Section.

APH staff and consultants.

Sadly, we also said farewell to Mamadou Lelenta and Eva Winger who retired in January and February respectively. Both did fantastic work in the Animal Production and Health Laboratory over many years and will be missed by staff and MS counterparts. If I can mention a few — Mamadou will be remembered for his outstanding contributions to the eradication of rinderpest and his expertise in the field of serology, and Eva — for her pivotal contributions to the development of the Trypanosomis ELISAs and recently, towards the development of an irradiated Trypanosoma vaccine. We wish them all the best in their changed careers.

Gerrit Viljoen,
Head, Animal Production and Health Section

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The Animal Production and Health Laboratory, Seibersdorf, is a collaborating Centre for ELISA and molecular technologies in animal disease diagnosis for the OIE

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Nuclear Techniques in Food and Agriculture

VETLAB Network Bulletin

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In this issue:

To the readers

It is a great pleasure to inform that the FAO Agriculture and Consumer Department awarded the Joint IAEA/FAO Division of Nuclear Techniques in Food and Agriculture (NAFA) and the FAO Animal Production and Health Division (AGA) with the Outstanding Teamwork Achievement Award for the exceptional contribution in assisting Member States during the avian influenza crisis.

In 2015, veterinary laboratories in West Africa have been challenged by the re-emergence of the highly pathogenic avian influenza (HPAI) virus belonging to the H5N1 subtype. The virus rapidly spread in the region, threatening public health and poultry farming. An urgent request for assistance was made to both IAEA and FAO to support the veterinary services.

Targeting 13 countries, an emergency action plan was formulated to tackle the HPAI-H5N1 outbreaks in Africa. Provision of diagnostic equipment and reagents and assessment missions were immediately undertaken by IAEA and FAO staff. Furthermore, a specific training course was organized and an "emergency toolbox" containing all the reagents necessary to perform the immediate screening for HPAI-H5N1 was provided to each participant. The VETLAB network has been actively involved and, with the assistance of IAEA and FAO, it has greatly facilitated the exchange of material, the shipment of samples and the confirmation of suspected cases.

VETLAB Highlights

Capacity building for the diagnosis of Ebola virus disease in Africa

Regional Training Course on Enhancing Capacity for Diagnosis of Ebola Virus Disease by Molecular Methods was conducted in April at the CDC laboratories at the Ugandan Virus Research Institute. Scientists from nine African countries attended this intensive course on biosafety and molecular diagnostics for highly pathogenic diseases. This was already the 3rd course on this topic and further training will be conducted towards end of the year.

Duplex real-Time RT-PCR detection and subtyping of H5N1 implemented in Cote d'Ivoire and Niger

The Laboratoire Central Veterinaire (LCV) in Bingerville, Cote d'Ivoire successfully identifying and typing influenza A viruses of H5N1 subtypes: Since, June 2015, the LCV Bingerville is using, in addition to a real-Time RT-PCR (RT-qPCR) for influenza A virus identification, a duplex RT-qPCR method, as front-line tools for the simultaneous detection of the haemagglutinin and the neuraminidase genes, allowing a faster and quicker subtyping of H5N1. The same protocol has been successfully implemented in the Laboratoire Central de l'Élevage (LABOCEL), Niamey, Niger.

Newcastle disease pathotyping in Mozambique

The Central Veterinary Laboratory of the Agrarian Research Institute of Mozambique can now pathotype Newcastle disease viruses circulating in the country for the first time thanks to the African Renaissance fund – Peaceful Uses Initiative (ARF-PUI) project.

OIE laboratory twinning on FMD in NAHDIC, Ethiopia

To strengthening the diagnostic capacity for Foot and Mouth disease and other TAD's in Ethiopia, NAHDIC launched a three year OIE twining project with WRLFMD-Pirbright on 13th-14th January 2016.

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VETLAB Network Bulletin

VETLAB Capacity Building Initiatives

Support missions

Six VETLAB partner laboratories (Cote d'Ivoire, Niger, Mozambique, Mali, Senegal, Mongolia) were visited by APHL staff in 2015. On these occasions, transfer of technology and capacity building activities focused on real time PCR diagnostics for avian influenza and multiplex detection of pathogens in small ruminants and swine.

Trainings

Fellows/interns from 6 VETLAB participating countries (Botswana, Burkina Faso, Myanmar, Mozambique, Sri Lanka, Tanzania and Zambia) were hosted in APHL in 2015. The trainings focused on the molecular techniques for the diagnosis of transboundary animal diseases and on genetic characterization of local cattle, sheep and buffaloes breeds.

In September 2015 one training course was organized on the early and rapid diagnosis of HPAI-H5N1. Twelve participants from ten Member States participated. One training course on 'Transboundary Animal Disease Diagnoses: Sequencing and Bioinformatic Analyses of Animal Pathogen Genomes' was held from 9-20 November 2015 at the IAEA Laboratories in Seibersdorf. Seventeen VETLAB Network veterinary diagnostic laboratory scientists from 12 Sub-Saharan African and 4 Asian countries participated.

VETLAB Networking Activities

Technical meeting with directors of veterinary laboratories of sub-Saharan countries

The second technical meeting with directors of African veterinary laboratories supported by the ARF and PUI initiatives to strengthen animal disease diagnostic capacities took place from 16-18 June 2015 at the IAEA Headquarters in Austria. Thirteen partner laboratories from 12 countries participated to the meeting. All participants provided updates on their progress and achievements in implementing the 2014 work plan, and on new emerging challenges. The participants highlighted the significant contributions of this project, particularly in bringing together several laboratories of Africa and sharing their experience and knowledge.

NVI, Ethiopia. The vaccine production facility under construction (March 2016)

The VETLAB Network laboratories

Starting from this issue of the bulletin, we intend to introduce the veterinary laboratories taking part to the network in Africa and Asia. The text is contributed by the network participants and the purpose is to briefly present the main activities, achievements and plans of the various laboratories.

The National Veterinary Institute (NVI) in Ethiopia (Ministry of Livestock and Fisheries Development).

1. *The laboratory mandate.* Vaccine research and development, veterinary vaccines production and distribution, production and distribution of biologicals and diagnostic kits.

2. *The laboratory activities.* Development of new vaccines, improvement of existing vaccines, production of diagnostic kits, production of around 21 viral and bacterial vaccines, vaccines quality control and assurance, provision of effective vaccines.

3. *A word about how the laboratory has evolved in the last 5 years.* NVI has strengthened R&D collaborations with FAO/IAEA, AU-PANVAC, North Carolina State University-College of Veterinary Medicine, and CIRAD-France.

4. *What do you want to brag about?* NVI is the only national vaccine production laboratory in Ethiopia and in the last eight months NVI vaccines have been exported to more than 10 countries in Africa. NVI has co-authored more than 25 peer review papers in the last 5 years. NVI contributes to building laboratory capacity nationally and internationally and wishes to be one of the best vaccine research and production laboratories in Africa.

5. *What are the laboratory objectives for the next 3 years?* Improve the lab facilities and strengthen the R&D activities, particularly on Marek disease and avian mycoplasmosis; improve the efficacy of existing vaccines (e.g. capripox; ovine and bovine pasturellosis); development of combined vaccines for poultry; increasing the number of accredited diagnostic tests; maintain the accreditation of QMS ISO 9001:2008; and implementation of GMP in the new production facilities.

Forthcoming events

Interlaboratory test for the diagnosis of PPR
The international interlaboratory test is expected to take off on the third quarter 2016. The main purposes of the exercise are to evaluate the capability of the participating laboratories to properly perform PPR laboratory tests and to provide the basis to facilitate test harmonization for PPR diagnoses.

Two (merged) training courses 29 August – 9 September 2016. (1st week) Sequencing services for member state; (2nd^{n}week) VETLAB Information Platform.

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Forthcoming Events

First Research Coordination Meeting on the Veterinary Diagnostic Laboratory Network "VETLAB Network" to Prevent and Control Transboundary Animal Diseases (TADs)

Technical Officers: Ivancho Naletoski, Charles Lamien

The research coordination meeting will take place from 15 to 19 August 2016 in Vienna, Austria.

The Committee for Coordinated Research Activities (CCRA) of IAEA has recently approved the new project proposal of the Animal Production and Health Subprogramme entitled 'Early detection of transboundary animal diseases (TADs) to facilitate prevention and control through a Veterinary Diagnostic Laboratory Network (VETLAB Network).

The project targets to establish five outputs: i) to develop and validate a set of internationally acceptable standards for the serological diagnostic techniques for priority diseases; ii) to develop and validate a set of internationally acceptable standards for the molecular diagnostic techniques for priority diseases; iii) to develop molecular procedures for simultaneous detection of multiple pathogens (multi-pathogen detection panels) for selected syndromic diseases of animals; iv) to develop a procedure for easy access, free-of-charge genetic sequencing services for the pathogens of priority diseases and v) to establish an information platform for integrated information collection, geo-visualization, analysis and decision making among the partners of the VETLAB Network. The project will integrate the research activities of ten research contract holders, three technical contract holders and several agreement holders, who will be responsible for the implementation of the project tasks.

The first research coordination meeting (RCM) of the project will aim at determining the technical solutions, such as priority diseases, priority diagnostic techniques, organization of the sequencing services and the components of the information platform. The conclusions and recommendations of the RCM will be used to upgrade and fine-tune the project work plan. Upon finalization, the project outputs will be disseminated to other Member States of IAEA and FAO through the technical cooperation programme, the capacity building component of IAEA.

Coordination Meeting with Directors of Veterinary Laboratories in Africa and Asia that are Supported by the African Renaissance Fund and the Peaceful Uses Initiative

Technical Officer: Charles Lamien

The technical meeting will take place from 16 to 18 August 2016 in Vienna, Austria.

Since 2011, IAEA has received support from the USA, South Africa and Japan to strengthen animal disease diagnostic capacities in selected sub-Saharan African countries. Two coordination meetings of that project were held in February 2014 and June 2015. A new proposal for PUI support of similar activities in Asia was granted in 2014 and the first coordination meeting with directors of Asian veterinary laboratories was held in 2015. During the two separate meetings for Africa and Asia, it was agreed that a joint coordination meeting will be held in 2016 with both African and Asian veterinary laboratory directors to promote the interaction between the two regions which are facing several common transboundary animal diseases. This will allow the sharing of knowledge, experience and create opportunities for collaboration.

Relying on regional laboratory networks, as those supported by FAO and the IAEA during the global rinderpest eradication campaign, has proven to be a highly efficient approach. It is anticipated that these directors of targeted African and Asian laboratories will meet at least once a year to discuss past activities and plan for the coming years. The meeting will allow both Asian and African laboratories members of the VETLAB network, which are supported through ARF and PUI, to review the work plans, share their experience, knowledge and identify areas of common interest for enhancing their capacity to better contribute to their respective national and regional TADs control strategies.

Regional Training Course on Enhancing Capacity of National Monitoring Teams for Diagnosis of Ebola Virus Disease (EVD) under High Bio-Safety Conditions RAF5073/003

Technical Officers: Hermann Unger, Ivancho Naletoski,

The training course will take place from 22 to 26 August 2016 in Yaoundé, Cameroon.

The course will be open to approximately 16 participants

from the below mentioned IAEA Member States in the region of Africa. Participating countries are encouraged to submit more than one application.

All African IAEA Member States. Priority will be given to the following States, which are considered at risk regarding emerging infectious disease outbreaks: Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Sudan, Togo, Uganda.

The purpose of the training course is to provide participants with theoretical and practical knowledge on the biosecurity measures required for personal, public and environmental protection, during sampling, packing, transport and submission of samples suspected to be affected by Emerging Zoonotic Diseases (EZD), including Ebola Virus Disease (EVD).

Experts Meeting on the Development of Guidelines for Recording Phenotypes in Breeding Sheep to Enhance Resistance to Gastro-Intestinal Parasites (RLA5071)

Technical Officer: Mohammed Shamsuddin

The meeting will take place from 22 to 26 August 2016 in Asuncion, Paraguay.

The regional experts meeting aims at reviewing the present sets of data collected and regional knowledge used by small ruminants breeders in parasite control practices. The meeting will discuss and identify further needs of information and tools for the collection, recording and management of data to develop and adopt state of the art in animal genetic characterization and use of genomic and phenotypic data in breeding, especially in relation to gastrointestinal parasites resistances in small ruminants.

Monitoring Teams for Diagnosis of Ebola Virus Disease (EVD) Under High Bio-Safety Conditions (in French) RAF0042/003

Technical Officers: Hermann Unger, Ivancho Naletoski

The training course will take place from 19 to 23 September in Yaoundé, Cameroon.

The purpose of the training course is to provide participants with theoretical and practical knowledge on the biosecurity measures required for personal, public and environmental protection, during sampling, packing, transport and submission of samples suspected to be affected by Emerging Zoonotic Diseases (EZD), including Ebola Virus Disease (EVD).

Regional Training Course on Enhancing Capacity for Diagnosis of Ebola Virus Disease (EVD) by Molecular Methods RAF0042/004

Technical Officers: Hermann Unger, Ivancho Naletoski

The training course will take place from 19 to 23 September in Uganda.

The purpose of this course is to build or enhance the human capacity to diagnose zoonotic diseases with a very high risk of infection transmission. After the training, the participants should be capable to (1) advice on biosafety standards to be implemented in the respective laboratories, (2) organize sample and work processes under these biosafety rules and (3) perform molecular diagnostics in safe conditions for the rapid diagnosis and confirmation of such diseases.

First Research Coordination Meeting on Application of Nuclear and Genomic Tools to Enable for the Selection of Animals with Enhanced Productivity Traits

Technical Officer: Mohammed Shamsuddin

The first RCM will take place from 3 to 7 October 2016 in Vienna Austria.

Ten research contract holders (RCHs) and four agreement holders are expected to attend the RCM.

Research contract holders will present their animal breeding and reproduction management systems and use of artificial insemination. They will focus on their plans to implement the research project into their dairy cattle production systems.

Agreement holders will present recent data on challenges and advances in sire selection in developing country situations, up-to-date methodologies for molecular marker data analysis for parentage testing and admixture analysis. The APH staff will present the existing resources that have been developed or optimized at Seibersdorf Laboratories, which could be applied on research contracts. The RCM will focus on evaluating and agreeing on the details of standardized work plans and protocols of work for the next 18 months, on SOPs, on training in field works and on general activities for the whole period of the CRP.

Technical Workshop: Remediation of Radioactive Contamination in Agriculture

Technical Officer: Ivancho Naletoski

The workshop will take place from 17 to 18 October 2016 at IAEA Headquarters, Vienna.

Breaking news – just as this newsletter was being finalized, the National Agriculture and Food Research Organization (NARO) of Japan and the Joint Division initiated a joint project to hold a technical workshop: Remediation of Radioactive Contamination in Agriculture.. Recovery from the Great East Japan Earthquake and the Fukushima Daiichi Nuclear Power Plant accident is an important cornerstone of NARO's R&D mission and it has been contributing to the development of decontamination technologies for farmland soil, and radionuclide transfer-control technologies for agricultural production. It is envisaged that the technical workshop will also include results of agricultural remediation activities from areas affected by the accident at the Chernobyl power plant. This year marks the 5th and 30th anniversary of both events respectively and there is considerable interest from our Member States on limiting the impact of radio caesium on agricultural production, including animal production. More details on the technical workshop are available at following webpage:

http://www-naweb.iaea.org/nafa/news/2016-FAO-IAEA-NARO.html

Regional Training Course on Sheep Genetics and Resistance to Parasites: Data and Samples Collection, Management and Analyses (RLA5071)

Technical Officer: Mohammed Shamsuddin

The training will take place from 24 to 28 October 2016 in Canelones, Uruguay.

The regional training course aims at enhancing knowledge and capacity building of participants on survey of sheep breed in relation to resistance to gastrointestinal parasites and recording, management and analyses of data on sheep, farm and production systems enabling implementation of breeding programme to enhance resistance sheep against gastrointestinal parasites.

Third Research Coordination Meeting on the Use of Stable Isotopes to Trace Bird Migrations and Molecular Nuclear Techniques to Investigate the Epidemiology and Ecology of the Highly Pathogenic Avian Influenza

Technical Officers: Ivancho Naletoski, Gerrit Viljoen

The third RCM will take place from 31 October to 4 November 2016 in Sofia, Bulgaria.

All research contract holders of the CRP D3.20.30 of the 'Use of stable isotopes to trace bird migrations and molecular nuclear techniques to investigate the epidemiology and ecology of the highly pathogenic avian influenza', will be invited to attend the meeting. They will discuss the results obtained from the three main project components: the detection of avian influenza virus in sampled migratory birds, stable isotope ratios in the feather samples as indicators for the long range migration of wild waterfowl and the results of the DNA barcoding of faecal and feather samples, used as a tool for non-invasive determination of the bird species.

As of September 2015, the research contract holders have collected approximately 3000 faecal samples and 1900 feather samples of wild migratory waterfowl. The faecal samples have been partly tested in the counterparts' laboratories and partly sent to the laboratory in Seibersdorf (positive samples) for further shipment / analysis at the avian influenza reference laboratory of Animal and Plant Health Agency (APHA) in Weybridge, UK. The feather samples (n=678) have been submitted to the University of Saskatchewan, Canada, for determination of the stable isotope profiles. The DNA barcoding of the feather samples began in December 2015 and is performed at the IAEA Laboratories in Seibersdorf. The CRP will be active until the end of 2017. The samples collected during 2016 and 2017 will be processed according to the existing work plan.

Regional (AFRA) Training Course on GIS Mapping in Support of Livestock, Disease and Vaccination Monitoring (RAF5068/005)

Technical Officers: Hermann Unger, Ivancho Naletoski

The training course will take place from 10 to 14 October 2016 in Accra, Ghana.

This training course is open for 25 participants from AFRA Member States in the region of Africa.

The training course aims to transfer knowledge in application of GIS and mapping tools to allow for the descriptive presentation of livestock population densities, animal disease events and surveillance or vaccination activities. The aim is that every participant has designed a map from his home country, linked up with excel spread sheets, indicating outbreaks, prevalence of a diseases or livestock population densities.

International Meeting on Emerging Diseases and Surveillance (IMED 2016)

The 6th International Meeting on Emerging Diseases and Surveillance, IMED 2016, will be held in Vienna, Austria from 4 to 7 November 2016.

For those whose work deals with threats from infectious agents, IMED 2016 will once again bring leading scientists, clinicians and policy makers to Vienna to present new knowledge and breakthroughs and discuss how to discover, detect, understand, prevent and respond to outbreaks of emerging pathogens. http://imed.isid.org/index.shtml

Consultants Meeting on the Early and Rapid Diagnostic Tools and Platforms

Technical Officer: Ivancho Naletoski

The consultants meeting will take place from 24 to 25 November 2016 in Vienna, Austria.

Consultants will meet to discuss the novel developments of the diagnostic technologies for detection of animal and zoonotic pathogens. The topics of the meeting will focus on point-of-care diagnostic tools and their use id detection and control of animal and zoonotic diseases.

Training Course on Transboundary Animal Diseases Diagnosis: Early Detection and Characterization

Technical Officers: Charles Lamien, Bharani Settypali

The training course will be held from 5 to 16 December 2016 at Seibersdorf Laboratories, Austria.

The purpose of this training is to promote the application of accurate and differential diagnosis of multiple pathogens in Member State veterinary laboratories.

This training will reinforce the participants' knowledge to detect, conduct surveillance, and perform epidemiological studies on the major viral and bacterial pathogens of transboundary nature which are associated with respiratory problems in small ruminants. Several diseases of small ruminants induce similar clinical signs, making disease recognition challenging. This is becoming more critical when several of these diseases are present at the same location. For instance, peste de petits ruminants disease, sheep pox and goat pox diseases, and contagious caprine pleuropneumonia are now endemic in several African, Middle Eastern and Asian countries with all four diseases causing similar respiratory symptoms in both sheep and goats. Differential diagnosis based on laboratory methods is therefore required to accurately diagnose peste des petits ruminants which can be easily confused with contagious caprine pleuropneumonia, pasteurellosis, contagious echtyma, or sheep pox and goat pox.

The training is designed for veterinary laboratory scientists with moderate experience in molecular diagnostics. Well recognized experts will deliver lectures and demonstrate the principles and practical applications of molecular and serological diagnostics, differential diagnostics and molecular epidemiology for PPRV, capripoxvirus and other ruminant pathogens. Practical training on serology, classical and real-time PCR, including multiple pathogen detection, and sequence analysis covering the same pathogens will be provided.

The course is open to veterinary diagnostic laboratory scientists from sub-Saharan African and Asian countries, members of the veterinary laboratory network supported by the IAEA Peaceful Uses Initiative (PUI) and African Renaissance Fund (ARF) projects.

A good background knowledge and laboratory skills in molecular biology are required.

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*Nominations for the TC programme should be submitted on the standard IAEA application form for training courses via the platform **InTouch**. Completed forms should be endorsed by and returned through the established official channels (the Ministry of Foreign Affairs, the National Atomic Energy Authority or the office of the United Nations Development Programme). http://intouch.iaea.org/*

Past Events

International Symposium on the Role of Agriculture Biotechnologies in Sustainable Food Systems and Nutrition

Technical Officer at APH: Gerrit Viljoen

The Symposium took place from 15 to 17 February 2016 at FAO Headquarters, Rome, Italy.

The objective of the symposium was to explore the application of biotechnologies for the benefit of family farmers in developing sustainable food systems and improving nutrition in the context of unprecedented challenges, including climate change. As underlined by the FAO Director-General José Graziano da Silva in his welcome address to the symposium: "We must count on a broad portfolio of tools and approaches to eradicate hunger, fight every form of malnutrition and achieve sustainable agriculture in the context of climate change".

The symposium used a broad definition for biotechnology derived from article 2 of the Convention on Biological Diversity and took a multisectoral approach, covering the crop, livestock, forestry and fishery sectors, and the use of microorganisms within these sectors. It focused on agricultural biotechnologies and products that are currently available and ready for use by small scale producers and family farmers. It covered low- and high-tech applications, such as microbial fermentation processes, biofertilizers, biopesticides, artificial insemination, tissue culture and the use of molecular markers for genetic improvement (so-called 'marker-assisted selection'). It also included genetic modification, used to make genetically modified organisms (GMOs).

An external Advisory Panel of 16 internationally recognized experts and stakeholders, including representatives from the private sector and the civil society, provided advice and guidance to FAO in organizing the symposium.

There were over 400 participants including 230 delegates from 75 member countries and the European Union, as well as representatives of intergovernmental organizations, private sector entities, civil society organizations, academia/research organizations and producer organizations/cooperatives. This included 63 invited speakers, chairs and moderators.

For more information and full report please refer to the web page http://www.fao.org/about/meetings/agribiotechs-symposium/en/.

First Regional Coordination Meeting Decreasing the Parasite Infestation Rate of Sheep (RLA5071)

Technical Officer: Mohammed Shamsuddin

The meeting took place from 29 February to 4 March 2016 in Buenos Aires, Argentina.

Small ruminant farming is a good means of livelihood improvement in most Latin American and the Caribbean countries but infection with gastro-intestinal parasite (GIP) incurs serious loss to farmers. Also alarming is the emergence of anthelminthic resistant parasites. The IAEA TC project RLA5071 project has been undertaken for the application of proven nuclear and nuclear-related molecular techniques to enhance host resistance to GIP and thus contribute to the control of GIP and sustainable increase in sheep and goats production at the national and regional level.

Participants at the regional coordination meeting.

The first regional coordination meeting was held to kick-off the project, present and discuss status data on small ruminants productions in participating countries, discuss and identify regional and national needs for capacity building on genetics and breeding for controlling GIP in sheep and goats, discuss and identify methods/tools to be developed/adapted for the implementation of project activities and to review and update individual country project work plan. The meeting was attended by ten national counterparts, seven local professionals, the ARCAL Coordinator and two IAEA staff.

Individual national counterparts presented their country status reports, which were followed by discussions. These helped understanding of national and regional capacities to address the controlling of GIP infection by increasing genetic resistance of sheep and goats to GIP. The discussions also helped individual counterparts updating national project work plans.

A workshop was conducted at the Agriculture Experimental Station, Concepción del Uruguay-INTA. A visit took place to INTA's sheep breeding facilities and experimental flock where lambs are challenged by artificial infections with infective parasite larvae and the resistant male ones are selected as potential sires.

Several discussion sessions were conducted to finalize the project work plan and the needs to strengthen capacities in participating Members States were assessed, so that essential requirements are met for the conduct of national project activities. This included (1) finalization of upcoming meetings, workshops and trainings dates, venues, potentials experts and lecturers, (2) identification of needs for equipment, kits, animal identification devices, etc. and (4) agreeing on the minimum essential data set for the formulation of individual country work plans. This was followed by individual consultation sessions among counterparts and the Technical Officer; counterparts from advanced laboratories also helped others to develop

individual country work plans, which were presented by counterparts, discussed and finalized.

National counterparts individually presented country work plans, which were discussed, updated and finalized.

Following are some of important conclusions made in the meeting.

- The project was well accepted and considered appropriate and timely to incorporate advanced genomic tools in breeding sheep and goats to enhance resistance to GIP in the region.
- GIP not only cause death of animals, loss of productivity, cost of veterinary care and anthelmintic but also increase risks of food contaminations by chemical anthelmintic.
- All participants updated and finalized their country project work plans for 2016–2017. Three countries (Argentina, Brazil, Uruguay) have already explored/incorporated resistance to parasites into sheep breeding programmes; they will be working on developing resistant sire lines for continuing breeding programmes. The remaining seven countries will be conducting a survey involving on-station and in the field collection of phenotypic data, DNA samples and prevalence of GIP infection in sheep and goats during the first two years. Later they will be analysing genotypes, phenotypes and their interactions for incorporating project results into small ruminants breeding programmes.
- The project work plan was discussed, revised and finalized. By fielding nine expert missions, conducting seven regional trainings and two expert meetings, providing minor equipment and consumables and harmonizing protocols and guidelines, regional capacities will be enhanced in the development, management and utilization of national and regional databanks on small ruminants performances and resistance to GIP, application of molecular genetics and assisted reproduction technologies to improve productivity of small ruminants in the region.

Report on Regional Training Course on the Use of RT-PCR for Rapid detection and Identification of Zika Virus (RLA5073)

Technical Officer: Ivancho Naletoski

Two training courses were held in Vienna Austria and Seibersdorf from 4 to 8 April and 11 to 14 April 2016.

The purpose of the training courses was to provide participants with technical knowledge and practical demonstrations on the use of qRT-PCR for the detection of Zika virus and its differentiation from similar viruses.

Objectives of the training courses:

I. Increased knowledge about Zika virus detection and its differential diagnosis from other viruses, such as chikungunya, dengue and West Nile virus, among others;

2. Increased knowledge about the epidemiology of Zika, chikungunya and dengue;

3. Improved capacity of participants to contribute to their national surveillance and control programmes and to national contingency plan preparation for Zika virus.

In response to the Zika virus outbreak in Latin America, the Caribbean and Marshall Islands, the IAEA has taken actions to support the affected Member States (MS). This action comes after the request for support of MS during the visit of the DG to Central America, and following the call from the WHO for coordinated global efforts to combat the Zika virus outbreak. The IAEA's activities are based around two major components: 1. Reverse transcriptase polymerase chain reaction (RT-PCR) for the rapid detection and identification of the Zika virus, and 2. Vector control through the sterile insect technique (SIT). The IAEA sent real time RT-PCR machines and reagents to seven countries in Central America and the Caribbean (Panama, Costa Riva, El Salvador, Guatemala, Honduras, Haiti and Nicaragua), and as part of efforts to strengthen the use of RT-PCR in the MS organized two one-week long training courses for professionals involved in the national laboratories responsible for the analysis of human specimen for detection of Zika virus. A total of 30 participants including physicians, microbiologists, entomologists and laboratory technicians, from 19 MS from the Latin America and the Caribbean region attended the training.

IAEA Director General Mr Yukiya Amano visits Zika trainees in Seibersdorf.

Participants came from countries that are experiencing outbreaks of Zika or other arboviral diseases such as chikungunya and dengue. In addition three participants from the African region (Angola, Algeria and Togo) attended the training; although no cases of Zika virus have been reported they have the presence of Aedes aegypti mosquito and have been dealing with dengue and

chikungunya. The training courses included both theoretical lectures and practical exercises and were conducted at the Joint FAO/IAEA laboratories in Seibersdorf and the IAEA Headquarters. The theoretical lectures covered a variety of issues pertaining to Zika virus and other similar viruses, including historical perspective and current status, epidemiology, aetiology, clinical presentation and complications, molecular and serologic diagnostics, and vector control through the sterile insect technique, among others. The practical exercises covered all the steps involved in the detection and identification of Zika virus and its differentiation from dengue and chikungunya, beginning from extraction of the viral genetic material to differentiation of the three viruses from specimens. Details on theoretical and practical part of the trailing course are provided in the extended report.

IAEA to Showcase Nuclear Science at Long Night of Research

More than 1300 visitors from the city of Vienna attended the IAEA Headquarters at the Vienna International Centre during the night of 22 April, when the Long Night of Research took place and the IAEA scientists hosted more than a dozen exhibition booths in the large rotunda.

Visitors had the opportunity to listen and pose questions to APH experts, who gave short, illustrated talks to explain how nuclear technologies can be applied to preserve animal health and welfare, combat diseases and improve animal production.

Visitors at the APH booth.

For example, the use of radio-isotopes technology in the development of vaccines to prevent diseases such as trypanosomoses was explained. Microscopes and monitors showing the living parasites attracted the attention of many visitors. The use of protective equipment to prevent the contact of persons with harmful pathogens was demonstrated and 'potential' young future scientists like those in the picture were trained on how to make delicate maneuvers wearing the thick, protective biosafety gloves. Short documentaries were displayed showing field applications and benefit of nuclear and nuclear-derived techniques to diagnose diseases and to improve animal production. Radio-particles, microorganisms, animals and humans got together in a unique, peaceful and successful event.

Revisiting Immunological Technologies for the Evaluation of Vaccines

Technical Officers: Hermann Unger, Viskam Wijewardana

The consultants meeting took place from 26 to 28 April 2016 at the VIC, Vienna.

The objectives of the meeting were to seek advice on identifying immunological technologies that would be important for the development of livestock vaccines. The title of the meeting was 'Revisiting immunological technologies for the evaluation of vaccines' and was attended by six consultants, two technical staff from University of Veterinary Medicine, Vienna and APH staff.

The overall purpose of the meeting was to review the current scientific status of the livestock immunology and its application in developing and evaluating vaccines. The Animal Production and Health Section of the Joint FAO/IAEA Division initiated a coordinated research project (CRP) on evaluating technologies for irradiated vaccine development by employing nuclear and nuclear-related technologies, five years ago. During this initiative, a number of promising vaccine candidates were identified against transboundary livestock diseases. However, without understanding the specific immune mechanisms involved in the protection from these diseases and the immune responses generated from vaccines, it is not possible to develop these vaccines further.

The consultants suggested that during the next CRP, IAEA could invest in developing an irradiated vaccine against Thilaria parva since the protection from this pathogen is evoked by cytotoxic lymphocyte response which could be induced by irradiated parasite. Consultants commended the protection by irradiated Haemonchus vaccine suggested that further animal experiments should be carried out to reproduce present data and also to investigate the protection from different strains of the parasite. With reference to the irradiated trypanosoma vaccine initiative, further experiments were recommended using a mouse model which will able to sustain the infection allowing an immune response that could be extrapolate in the natural host.

The effect and use of vaccine adjuvants was also discussed during this meeting and it was shown how to monitor the effects of local and systemic immune responses. These experiments will be very useful to monitor the effects of adjuvants used in livestock vaccines. Irradiated pathogens could be used as vaccine adjuvants since they deliver strong 'danger signals' to the immune system. Therefore, in future, the use of irradiated pathogens to upgrade the

immune response from already available vaccines could be investigated.

Meeting participants.

The consultants agreed and advised IAEA to invest in scientific leadership in selected laboratories in Member States to increase the capacity in immunological research pertaining to vaccine development. They also made recommendations to widen the scientific capacity at Seibersdorf laboratories in terms of immunological tools and reagents that will enable Member States to carry out vaccine development and evaluation. APHL was also asked to take the leadership in designing experiments, providing tools and training scientists from Member States in livestock vaccine research and development.

In terms of tools to evaluate vaccine responses, qPCR and ELISA/ bead based multiplex arrays to measure cytokine, ELISPOT and flow cytometry based experiments to measure cellular immune responses were recommended by the consultants. It was also discussed that Seibersdorf laboratories could play a lead role to develop and disseminate these techniques.

New Approaches and Applications of Radiation Hybrid Mapping for Development of Animal Genetic Tools in the Genomic Era

Technical Officers: Mohammed Shamsuddin, Kathiravan Periasamy

The consultants meeting took place from 24 to 27 May 2016 at the VIC, Vienna. The meeting was attended by six consultants, one FAO and five APH staff.

The consultants meeting aimed at reviewing the current status of scientific information related to radiation hybrid maps of livestock genomes, exploring new approaches to improve the construction of radiation hybrid panels and widen the application of radioisotope technology in the field of animal genetics and breeding.

Participants at the consultants meeting.

During the meeting, the discussion focused on the importance of chromosome assemblies of genomes in designing effective animal genetic tools, applications in animal breeding and assessment and conservation of livestock biodiversity. It was confirmed that radiation hybrid maps still play a significant role in chromosome assembly of genomes, particularly those of less studied animal species of agricultural interest whose improvement is important to extend food chain and enhance food security. The animal species that are to be targeted on priority were identified, for example camel, buffalo, zebu cattle, yak, donkey, quail, guinea fowl, pigeon.

The meeting participants commended the current initiative by the Joint FAO/IAEA Division to develop a radiation hybrid panel for camels, an agriculturally important species that contribute to the livelihood of several million nomadic pastoralists in Africa and Asia. The meeting identified potential challenges in mapping the camel genome and proposed suitable strategies based on nuclear technologies to overcome the difficulties. Particularly, important suggestions were made on the radiation dose required to construct the camel radiation hybrid panel and novel approaches for cost-effective high-throughput genotyping and characterization of the panel.

The meeting participants agreed to prepare a review/status paper highlighting the gaps, issues and potential solutions for chromosome assembly of sequenced genomes. The outline of the review/status paper entitled "Why chromosome assembly for animals is still such a challenging puzzle?" was finalized with formation of different working groups that will draft the manuscript for various topics identified during the meeting.

The meeting supported the implementation of the recent initiative on the construction and characterization of radiation hybrid panels for camels and its extension to other less studied animal species of agricultural importance.

A radiation dose of 5000 rad will be used for the construction of radiation hybrid panel to improve the integrity of chromosome assembly of the camel genome. This will be done in addition to the 96 clones developed by

the Animal Production and Health Laboratory, Seibersdorf with a radiation dose of 15 000 rad.

With the absence of a camel specific sequence array, next generation sequencing with low coverage will be the preferred choice of characterizing camel radiation hybrid panels.

Adequate cost-effective mapping tools, open source pipelines for data integration and building capacity on bioinformatics data analysis are required to improve genomic information, particularly on less studied but agriculturally important animal species.

It is important that the Joint FAO/IAEA Division continues and expands its efforts to develop animal genetic tools for the improvement of less studied species of agricultural importance including camel, buffalo, yak, donkey, reindeer, quail, guinea fowl and pigeon.

The Joint FAO/IAEA Division should initiate the development of a universal sequence array for the characterization of radiation hybrid panels of various species of agricultural importance.

The FAO/IAEA Laboratories at Seibersdorf should serve Member States as a hub for the coordination of construction and distribution of radiation hybrid panels, relevant biological reference materials, mapping resources and software tools for agriculturally important animal species.

Regional Workshop under RER9137: Enhancing National Capabilities for Response to Nuclear and Radiological Emergencies (Component on the Re-enforcing Veterinary Authorities to Respond to Nuclear Emergencies)

Technical Officer: Ivancho Naletoski

The workshop was held from 23 to 27 May 2016 at the IAEA Headquarters in Vienna.

The topic of the workshop was to review the international emergency preparedness response standards and examine the veterinary authority participation in the response mechanisms.

The workshop included presentations and group discussions on i) project work plan review and improvement, ii) review of the existing emergency preparedness structures for response to nuclear and radiological emergencies, as well as the existing national emergency/contingency plans for general disaster management in MS and iii) mechanisms to integrate the nuclear and radiological emergency preparedness and response plans into the overall disaster management plans for the animal production systems.

Participants at the workshop under TC project RER9137 at the IAEA Headquarters in Vienna.

Relevant experts from IAEA Incident and Emergency Centre (IEC), international organizations, FAO-Crisis Management Centre (Dr Ludovic Plée), the OIE ad hoc Group on disaster risk reduction and management in relation to animal health and welfare (Dr Gary Vroegindewey) as well as an veterinarian expert from the Federal Emergency Management Agency (FEMA) of USA (Dr Sebastian Heath) have presented the existing concept on preparedness of veterinary authorities in disaster management and guided the solutions on how to integrate the requirements of the IAEA nuclear and radiological standards for emergency preparedness and response into these concepts. Based on the discussions, conclusions and recommendations, the participants at the meeting have outlined the skeleton of the response structure for the veterinary authorities.

Thirty-two participants from 20 Member States of the European region attended the meeting.

Coordination meeting on the RAF5073: Strengthening Africa's Regional Capacity for Diagnosis of Emerging or Re-emerging Zoonotic Diseases, including Ebola Virus Disease (EVD), and Establishing Early Warning Systems

Technical Officers: Hermann Unger, Ivancho Naletoski

The coordination meeting was held from 14 to 17 June 2016 in Accra, Ghana.

It is organized as a One-Health meeting integrating the veterinary and the public health sectors. The aim of the meeting was to discuss the priority diseases for individual countries and for the region as a whole, as well as the currently available technologies for early and rapid detection of the emerging and re-emerging zoonotic diseases in Member States of the African region. Based on the meetings' recommendations, the coordination team fine-tuned the work plan of the project to enable adaptive capacity building and technology transfer. Forty-one

participants from 21 Member States will attend the meeting.

Second Research Coordination Meeting on the Early and Rapid Diagnosis and Control of African Swine Fever (ASF)

Technical Officer: Hermann Unger

The second research coordination meeting (RCM) of the coordinated research project (CRP) on 'Early and rapid diagnosis and control of TADs – second phase African swine fever' D3.20.21 took place from 20 to 24 June 2016 in Vienna, Austria.

Nine research contract and agreement holders as well as an expert from UK and a member of the International Livestock Research Institute participated in the meeting.

The meeting report will be available in the next newsletter.

Stories

IAEA Helps Bulgaria Tackle Cattle Disease with Nuclear-Derived Technique

The International Atomic Energy Agency (IAEA) is providing laboratory support and expertise to help Bulgaria battle a cattle disease that can cause significant economic losses to farmers.

In response to a request from Bulgarian authorities, the planned assistance totalling EUR 50 000 will enable the fast and accurate detection of the virus that triggers lumpy skin disease, which can spread quickly within herds and affect milk, beef and leather production. The IAEA is delivering this support in partnership with the Food and Agriculture Organization (FAO) and the European Commission.

Common in Africa and the Middle East, the infectious disease has occurred in parts of south-eastern Europe in recent years. It has a mortality rate of up to 10 percent, according to the World Organization for Animal Health (OIE). The OIE says the disease should be notified to authorities so that rapid action can be taken to contain it.

The IAEA's assistance includes support in using a nuclear-derived technique – Polymerase Chain Reaction (PCR) – to detect the virus within three hours. PCR has previously been deployed to help West Africa cope with the Ebola outbreak in 2014 and the H5N1 avian influenza in 2015, and Latin America during this year's Zika virus emergency. The Agency will also deliver laboratory material, including reagents, primers and probes.

"The early and accurate detection of lumpy skin disease is essential in order to take appropriate measures to contain spreads, such as imposing cattle movement restriction and culling," said Technical Officer Ivancho Naletoski of the IAEA's Department of Nuclear Sciences and Applications.

"Due to the increased demand for vaccines, the producer from South Africa cannot quickly meet demand from abroad."

Upon notification in April, IAEA staff carried out expert visits to laboratories in Bulgaria to advise on improved PCR testing procedures and help determine the extent of the spread of the disease. In addition, the IAEA is assisting Bulgaria and its neighbours in developing harmonized laboratory testing procedures and in submitting samples to international reference laboratories.

Lumpy skin disease is transmitted through direct contact with infected animals and contaminated products, as well as insect vectors. Skin lesions in affected cattle can damage hides and cause severe emaciation and a halt to milk production. Turkey reported its first cases in 2013, followed by Greece in 2015. The Bulgarian veterinary authorities have declared LSD outbreaks to OIE in April 2016 with other East European countries following as the disease spreads. The disease does not affect humans.

The joint IAEA/FAO animal production and health laboratory has decades of experience in applying nuclear and nuclear-related techniques to fight various animal and zoonotic diseases, such as rinderpest and avian influenza.

https://www.iaea.org/newscenter/pressreleases/iaea-helps-bulgaria-tackle-cattle-disease-with-nuclear-derived-technique

IAEA Technical Support to Botswana National Veterinary Laboratory: Regional Impact

Botswana is considered as a middle-income country having one of the fastest growing economies in Africa during the last decade. Diamond export is the main factor behind high growth rates in recent years as it accounts for more than one-third of GDP. Despite this, the agricultural sector remains a fundamental source of subsistence. Livestock production is an important socio-economic activity in the farming communities where the cattle

industry is the principal sector with a major contribution to beef export to the EEC market.

There are 2.5 million heads of beef cattle, 0.6 million heads of dairy cattle, 1 million goats and 0.5 million sheep among other livestock species. In this scenario, transboundary animal diseases such as foot-and-mouth disease (FMD) and contagious bovine pleuropneumonia (CBPP) can have significant socio-economic impact. These diseases continue to be a threat for livestock productivity in the country since the diseases are present in the neighbouring countries and FMD is also present in various countries in the region including Botswana.

The Botswana National Veterinary Laboratory (BNVL) has the mandate to carry out testing of samples for animal disease diagnosis and surveillance. The laboratory used to rely more on conventional test methods, which are not sensitive and fast enough to provide timely and reliable results contributing to early disease detection and response. The diagnostic capacity needed to be strengthened by training and through the introduction of modern techniques like PCR and isotopic methods for confirmatory diagnosis thereby helping to adopt effective disease control.

CBPP is a cattle lung disease which is endemic in Southern Africa, occurring in Angola, Democratic Republic of Congo, Namibia and Zambia. Botswana had an outbreak in Ngamiland in 1995 after 56 years of freedom from the disease. However, the disease was eradicated through slaughter policy in 1997.

To prevent reoccurrence of CBPP, early detection is of paramount importance for controlling the disease.

Abattoir and serological surveillances are carried out in high risk areas of Botswana. Previously abattoir surveillance used histological examinations of lung tissues while Complement fixation test was used for sero-surveillance. The IAEA supported introduction of molecular diagnostic techniques and improvement of serological testing capacity at BNVL through provision of training of laboratory personnel, reagents and equipment. The surveillance for CBPP carried out in 2013–2015 demonstrated that the country is still free from disease (Table).

Year	**Test**			
	CFT		PCR	
	Number of samples tested	Results	Number of samples tested	Results
2013	347	Negative	To be provided	Negative
2014	1.749	Negative	To be provided	Negative
2015	1.916	Negative	To be provided	Negative

The capacity attained with the help of IAEA and the collaboration with national and international laboratories resulted in BNVL being granted the status of an OIE reference laboratory for CBPP in May 2012. As an OIE reference laboratory, BNVL is contributing to the control of CBPP in the SADC region and beyond through provision of critical reagents, training and organization of ring trials for CBPP diagnostic tests.

To effectively control CBPP in the region collaboration amongst national laboratories is important. Considering that neighbouring countries Namibia, Zambia and Angola have the disease, a network was formed in 2014 involving the three SADC countries. The objective of this network was for BNVL as a CBPP reference laboratory for OIE to engage these countries and assist in their CBPP control strategies. The Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale' (IZS) of Italy, another OIE reference laboratory for CBPP was engaged as a technical partner.

The CBPP Network achieved its objective resulting in improved collaboration with reduced prevalence of CBPP in Namibia and Zambia and improved surveillance and diagnostic capacities for Angola.

The CBPP Scientific Network aims to expand its scope to include the entire SADC region and include other TADs including PPR, FMD and NDV. The overall objective is to achieve Regional Eradication Strategy for SADC.

IMPROVING DIAGNOSTIC CAPACITY FOR FMD AT BNVL

Foot-and-mouth is a disease of cloven hoofed animals which causes serious production losses and is a major constraint to trade in livestock and their products. Botswana exports 80% of its beef to the European Union

and an out break of FMD leads to temporary closure of this market with severe social and economic costs.

Department of veterinary services (DVS), has developed and is implementing an FMD control strategy to ensure effective control of the disease in Botswana.The BNVL has developed capacity for serological testing for FMD and hence supports the DVS in the annual surveillance programs.

The BNVL utilizes the structural protein test liquid phase blocking – Enzyme-linked Immunosorbent Assay (lpb-ELISA); the OIE recommended test for international trade. This test was accredited in 2009. The non-structural protein test (NSP-ELISA) was set up to complement lpb-ELISA in detecting antibodies due to infection.

The BNVL experienced challenges in the optimization of the serological tests and IAEA assisted the laboratory by providing training through a fellowship and scientific visit at OVI in September 2012. This was followed by an expert visit from WRLFMD, Pirbright in November 2012.

This support improved the diagnostic capacity for FMD through stabilization of LPBE and establishment and eventual accreditation of NSP ELISA.

The IAEA also provided reagents for testing and this facilitated successful implementation of the surveillance plans assuring continued access to local and international markets.

The laboratory has been able to test 70 064 serum samples for FMD surveillance from various districts of Botswana from 2013–2015. One of the outcomes of this surveillance was the contribution to the recognition of zone 6 as FMD – free status without vaccination by the OIE in 2013.

IMPLEMENTATION OF THE MANAGEMENT SYSTEM AT BNVL

BNVL has been implementing quality management system according to ISO 17025 Standard and accredited seven tests in 2007. Implementation of the management system is important in assurance of quality of test results as this is required to effectively control diseases in the country and to meet customer demands.

The IAEA supported BNVL in the improvement of the management system through one scientific visit to IZS, Italy; one expert mission on implementation of management system in molecular laboratory at BNVL. The Deputy Quality manager attended one week training course on QMS in Harare, Zimbabwe in 2015.

This led to the increase in the number of accredited tests by 2015 to 41 tests in various disciplines. Accreditation is an on-goining process which requires continuous improvement. This has contributed to the competetiveness of the livestock industry in accessing international markets. This has also resulted in Botswana being a destination for benchmarking visits by other African countries.

CAPACITY BUILDING FOR OTHER COUNTRIES

BNVL has also contributed in IAEA supported capacity building as a training institution for various countries including Uganda, Ethiopia, Zambia, Malawi and Mozambique.

Eritrea moves to develop smallholder dairying to improve rural livelihood and food security

Eritrea is located between Djibouti and Sudan, and bordering the Red Sea. The country has about 6.5 million people in a land area of 117 600 sq. km. At least three distinct climatic zones are in Eritrea: (1) a hot, dry desert strip along the Red Sea coast, (2) a cooler and wetter area in the central highlands and (3) a semiarid zone in western hills and lowlands. Only 6.8% of the land is arable and about 68% is considered as grassland. According to a census in 2012, Eritrea has 1.9 million cattle, 2.1 million sheep, 4.7 million goats, 0.3 million camels, 0.5 million equine and 1.1 million poultry. Nearly 80% of the population is engaged in subsistence agriculture and livestock has remained crucial to rural livelihood. Improving livestock productivity in Eritrea means better livelihood and contribution to strengthen food security.

Eritrean major challenges to develop the livestock sector are poor productivity due to unknown of productive performance data, lack of an appropriate genetic selection of indigenous livestock, shortage of feed due to erratic rain fall and frequent drought and high prevalence of infectious animal diseases, many of them of transboundary risk. Government's strives has been supported by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture for building national capacity on the application of nuclear and nuclear related techniques to improve livestock productivity.

IAEA support is focused on building institutional capacity by training personnel, providing with required laboratory equipment and expert advices on the optimization and harmonization of protocols for feed analyses, delivering artificial insemination services to farmers and early and rapid diagnosis of major infectious diseases. Since 2012, six national training courses were implemented where

internationally recruited experts trained nearly 70 local scientists and technicians on aspects related to animal nutrition, reproduction and health. These enhanced capacities enabled the National Agricultural Research Institute (NARI) to attract collaborations with VITA, an Irish NGO, which have come forward to support the development of smallholder dairying and thus reduce poverty and enhance food security in Eritrea. NARI provides technical supports to farmers on forage cultivation, feed formulation, animal health care, etc., through on-site advice and group trainings. NARI's supports to farmers have been instrumental to the implementation of the smallholder dairying. As an example, using feed analyses data, NARI has helped farmers to use improved feeding strategies for dairy cattle by incorporating alfalfa, maize, barley and wheat straws and concentrates in the diet and therefore doubling milk production in many situations. These interventions should be continually implemented in farms who have not yet adapted such an improved feeding practice.

In 2014, the disease diagnostic laboratory analysed more than 6000 samples for a better control of livestock and poultry diseases. Both ELISA and polymerase chain reaction (PCR) techniques are routinely used in the laboratory using internationally accepted SOPs and under the guidance of the Joint FAO/IAEA Division.

Based on successes made from this pilot interventions, IAEA supports to NARI and thus to farmers should continue on strategizing the selection of breeding animals for an improved artificial insemination field service coupled with continued technology development for feed production and the control of infectious and production limiting animals diseases.

H5N1 Avian Influenza – the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture (NAFA) awarded for its continuous support to affected countries in Africa

The H5N1 avian influenza virus re-emerged in West Africa in January 2015. Since then, the virus has been responsible for the death of millions of domestic birds in several African sub-Saharan countries, including Burkina Faso, Cote d'Ivoire, Ghana, Niger and Nigeria. Not only this virus is threatening the local economies and food security but it represents a serious public health threat as it can infect and cause severe disease in human beings.

Since 2006, when the virus was for the first time reported in Africa, IAEA in partnership with FAO has assisted Member States of the region in controlling the epidemic by implementing capacity building activities, providing equipment and laboratory reagents, facilitating networking and sharing of information and material. Thanks to the surveillance and control efforts implemented at that time, H5N1 was eradicated from the region and the last outbreak was reported in Nigeria in 2008.

However, the avian influenza virus remained endemic in the wild and domestic bird population of several Asian countries and in Egypt with sporadic incursions into other continents such as Europe and Africa. The re-emergence of the disease in West Africa in early 2015 prompted to an immediate response of Animal Health of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and the FAO Animal Production and Health Division.

They quickly provided to Member States emergency kits, containing all the necessary disposables, PPE, reagents and controls to rapidly implement H5N1 laboratory diagnoses and conducted field missions in some of the H5N1-affected or threatened African countries such as Cote d'Ivoire, Ghana, Mali, Niger and Senegal. During these missions, laboratory equipment was checked and updated; trainings and transfers of laboratory procedures for avian influenza were ensured. In some laboratories, new real time PCR platforms were installed (e.g. in Cote d'Ivoire, Ghana and Mali), making the H5N1 diagnoses faster and accurate. Furthermore, a 5-days laboratory training course in Seibersdorf was organized. The course enabled 12 participants from 10 Member States (Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Cote d'Ivoire, Ghana, Niger, Togo and Zimbabwe) to refresh and enhance their knowledge in the rapid diagnosis of H5N1.

Although the number of reported outbreaks has been reducing in the first half of 2016, the H5N1 virus is still present in the region with the last cases reported from Ghana last April. The VETLAB Network supports Member States to fight against this transboundary and zoonotic disease. The assistance and the capacity building activities implemented by IAEA in collaboration with FAO enabled the targeted laboratories in Member States not only to be self-reliable in the rapid diagnoses of the H5N1 infection, but also to act themselves as a supportive centre for other laboratories in the region with more limited resources. The up to date laboratory equipment and testing procedures provided in 2015 have made possible the detection and typing of the virus in a faster and more accurate manner locally, reducing the time lapse between disease suspicion and confirmation thus improving the control of avian influenza in Africa.

The contribution of IAEA and FAO Animal Health to combat H5N1 infection has been recently acknowledged by awarding the team for its 'Outstanding Team Work Achievement' in controlling avian influenza in Member States. This award was assigned by the Agriculture and Consumer Protection Department of FAO in 2016.

The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture on the front-line to combat the emergence of lumpy skin disease in Europe

Lumpy skin disease (LSD) is a viral disease affecting cattle which is endemic in several countries in Asia and Africa. The disease can be acute or sub-acute and characterized by extensive skin lesions. In addition, lesions in the respiratory and digestive tracts can bring the animals to severe emaciation and death. The virus is transmitted by direct contacts between infected and healthy animals, by indirect contacts with contaminated materials and by vectors such as flies and ticks. The disease can spread rapidly between animals and between farms, crossing national borders and causing major epidemics with severe economic losses to farmers and national economies due to mortality, drop in production and international trade ban of animals and animal products. For these reasons, the World Organization for Animal Health (OIE) included LSD in the listed diseases with mandatory immediate notification in case of first occurrence in a country.

A cow affected by lumpy skin disease in Bulgaria – poor general condition and typical skin lesions.

Before 2015, Europe was considered free of the virus and the disease was therefore considered exotic. However last year cases of LSD were reported in Greece and very recently (April 2016) the disease was reported for the first time in Bulgaria and the Former Yugoslavian Republic of Macedonia (FYROM). To date, these two countries notified OIE 17 and 21 outbreaks respectively with tendency for further spread within and between the countries in the region. Although the virus does not infect humans, if not contained, the infection can cause huge economic losses to the livestock sector in neighbouring countries and the whole European Union. In response to an urgent request from Bulgaria, IAEA in collaboration with FAO has rapidly implemented an emergency response plan to support Bulgaria and other Member States in the surveillance and control for this disease.

Just a few days after the first notification of LSD in the country, two animal health experts from the IAEA Animal Production and Health Section (APH) conducted an assessment mission in Bulgaria to evaluate the needs of the Veterinary Services and the laboratory in terms of disease diagnoses and surveillance. The IAEA experts also advised on improved testing procedures based on the Polymerase Chain Reaction (PCR) and deliver laboratory material enabling for early pathogen detection and differentiation. Additionally, a diagnostic package for advance sequence analysis, enabling Bulgarian veterinary authorities for in depth understanding of the circulating LSD viruses in the country has been developed. IAEA has rapidly mobilised 50 000 euro for the immediate and medium terms support for sampling, sample processing and diagnostic testing. This will be followed by laboratory trainings in the Joint FAO/IAEA Division laboratories in Seibersdorf, supported by the US Animal and Plant Health Inspection Service (APHIS), for the use of advanced techniques for detection and differentiation of the poxvirus infections. The trainings will target laboratories of 33 countries in Europe and Central Asia affected or threatened by the disease. To enable countries to be prepared for the emergency, APH is providing primer sets for the recommended LSD diagnostic techniques together with the non-infectious positive controls for PCR-based assays. Furthermore, an instruction package and a reserved budget to enable Member States access to a free-of-charge sequencing service were prepared. The package includes guidelines on how to prepare and submit the samples, basic interpretation of sequencing data, instructions on record keeping and result sharing, as well as continuous support in problem solving by the APH scientists from the Seibersdorf laboratory. This package will also be included in the training courses.

The VETLAB in action: the Laboratoire Central Vétérinaire in Bamako detected the first cases of African swine fever in Mali

The Laboratoire Central Vétérinaire (LCV), Bamako, Mali, a member of VETLAB Network, is currently supported by Africa Renascence Funds and the technical cooperation project MLI5026 of the Joint FAO/IAEA Division.

During the first technical meeting of laboratory directors of the VETLAB network, LCV requested support from the Joint FAO/IAEA Jivision to strengthen their molecular diagnostics capacity, through the provision of equipment, reagents and supplies, and also requested a technical field support mission. In 2015, LCV was supplied with real time PCR equipment which was installed during an expert mission by APH staff. During this mission, fifteen scientists of LCV were trained on nuclear-derived, real time PCR-based diagnostic assays for African swine fever (ASF), peste des petits ruminant (PPR), capripox, and influenza (H5N1). Additionally, the LCV staff was trained to perform multiple pathogen detection assays for pathogens causing respiratory diseases in small ruminants and pox like diseases in ruminants and camels. To allow

for the swift implementation of these techniques, the laboratory was supplied with all appropriate reagents and consumables needed to perform these tests.

This training and provision of equipment and reagents enabled the laboratory to improve pathogens detection and disease diagnoses, also increasing the portfolio of pathogens the laboratory is capable to directly reveal in clinical samples.

Operating the real time PCR protocol to detect ASF virus at the Laboratoire Central Vétérinaire (LCV) in Bamako, Mali.

The positive outcomes for these efforts became soon evident. Mali, which has previously been considered free of ASF, has reported its first outbreak of ASF to the OIE in February 2016, based on the results generated by LCV, using real time PCR techniques.

The ASF virus outbreak occurred in January 2016 in the village of Saniky (Prefecture of Tominian) in the Region of Segou) causing disease in 50 Pigs and killing 7) animals at the onset of the disease. The outbreak was immediately investigated by the LCV and the results were communicated rapidly to the appropriate authorities, allowing the implementation of appropriate measures to stabilize the situation.

The targeted supply of equipment, reagents and the duty travel undertaken in the lab has significantly enhanced the ability of LCV to cope with the diagnostics of additional diseases and in the present case, helped to quickly diagnose ASF, implement appropriate control measures and report the disease according to the international regulations. It is of importance to mention that local authorities in several African countries are more and more relying on the results of their local veterinary diagnostic laboratories to report diseases nationally and to the OIE, although they are keeping on submitting samples or isolates to international reference laboratories for further characterization of pathogens. This indicates an increasing trust of the local laboratories due to the improvement in the quality of their services, thanks to the support of a technical partner such as the Joint FAO/IAEA Division.

Peste des petits ruminants (PPR)

Peste des petits ruminants (PPR) is a contagious and often fatal disease affecting sheep and goats. Currently, it is endemic in Africa, the Middle and Near East, the Indian subcontinent and China. The control of PPR is considered an important element in the fight for global food security and poverty alleviation and it is for this reason that the disease has been chosen as the next animal disease for global eradication.

In LAO PDR caprine production plays an important role in the socioeconomic development of the country. To date, PPR has not been reported in the country but since LAO PDR shares a border in the north of the country with China the threat of PPRV incursion exists. The IAEA technical cooperation project LAO5003 is focusing on the use of nuclear and nuclear-related technologies for the early and rapid diagnosis and control of transboundary animal diseases in livestock in LAO PDR with PPR being one of the main diseases being targeted. With this in mind, and in collaboration with the VETLAB network, of which LAO PDR is a member, an expert consultant from the Animal Health and Production Laboratory (APHL) of the Joint FAO/IAEA Division visited the National Animal Health Laboratory (NAHL), Department of Livestock and Fisheries, Ministry of Agriculture and Forestry, Vientiane, Lao PDR for five days (18–22 April 2016). The principal aim of the visit was to transfer a number of diagnostic protocols for animal disease present in the country in addition to increasing preparedness of the laboratory for the possible incursion of new TADs with particular attention to PPR.

The expert trained the laboratory staff on the use of two molecular diagnostic protocols for the detection of PPR. One of these protocols has been recently developed by APHL and is a one-step multiplex RT-qPCR assay that simultaneously detects Capripoxvirus, PPRV, *Pasteurella multocida* and *Mycoplasma capricolum ssp. capripneumonia* in pathological samples collected from small ruminants with respiratory disease symptoms. The second protocol is a robust and sensitive conventional RT-PCR that allows for confirmation of the presence of virus and then lineage identification following sequence analysis. At the end of the training the NAHL staff had the capacity (reagents and controls were supplied by APHL) and technical expertise to diagnose and characterize PPRV using both the Real-time and conventional molecular diagnostic protocols. As a result, the country is now prepared to diagnose and confirm any future incursions of PPR into LAO thereby fulfilling an essential requirement of the FAO/OIE Global Eradication Strategy for PPR.

These stories as well as other articles are also available under 'Highlights' on our Homepage
http://www-naweb.iaea.org/nafa/aph/index.html

Coordinated Research Projects

Project Number	Ongoing CRPs	Project Officers
D3.10.28	Application of Nuclear and Genomic Tools to Enable for the Selection of Animals with Enhanced Productivity Traits	M. Shamsuddin, K. Periasamy
D3.10.29	Quantification of intake and diet selection of ruminants grazing heterogeneous pasture using compound specific stable isotopes	M. Shamsuddin M. Garcia Podesta
D3.20.29	The use of irradiated vaccines in the control of infectious transboundary diseases of livestock	H. Unger G.J. Viljoen
D3.20.30	Use of stable isotopes to trace bird migrations and molecular nuclear techniques to investigate the epidemiology and ecology of the highly pathogenic avian influenza	I. Naletoski G.J. Viljoen
D3.20.31	Early and rapid diagnosis and control of TADs – second phase- African swine fever	H. Unger G.J. Viljoen
D3.20.32	Early detection of transboundary animal diseases (TADs) to facilitate prevention and control through a veterinary diagnostic laboratory network (VETLAB Network)	I. Naletoski C.E. Lamien
Planned CRP	Irradiation of Transboundary animal disease (TAD) pathogens as vaccines and immune inducers	H. Unger

Application of nuclear and genomic tools to enable for the selection of animals with enhanced productivity traits (D3.10.28)

Technical Officers: Mohammed Shamsuddin, Kathiravan Periasamy

The objective of the CRP is to enable Member States (MS) to use genomic tools coupled with artificial insemination (AI) programmes for enhancing the efficiency and effectiveness of genetic improvement of livestock. Nuclear and nuclear-derived molecular techniques will be applied to address two major issues prevailing in developing countries, which are directly associated with food security and livelihood improvement. Firstly, it will generate genomic data of performance recorded animals, which will enable breeders and farmers relate production traits with parentage and genetic admixture of animals leading to identification and selection of superior sires for breeding by using artificial insemination. Secondly, ^{60}Co will be applied to develop a radiation hybrid panel of camel and use that for whole genome sequencing and identification of DNA markers for camel breeding. As outputs, the project is expected to leave behind in each participating country an animal identification system in place, 1000 phenotype recorded cattle/buffalo per breed/population from and a gene bank of phenotype recorded animals. Further, it will validate genetic tool (s) for testing parentage, relationship and admixture level, develop whole genome radiation hybrid panels for camel, develop a set of performance data for different genetic groups in different production systems and deliver SOPs, protocols and guidelines for continued animal genetic research and application of results in animal breeding.

Ten 10 research contract holders and four agreement Holders are being selected. The APH laboratory has already initiated the process of developing a camel radiation hybrid map. A consultants meeting was already held and expert guidance and recommendations are incorporated in the laboratory protocol for the development of a radiation hybrid map.

Quantification of intake and diet selection of ruminants grazing heterogeneous pasture using compound specific stable isotopes (D3.10.29)

Technical Officers: Mohammed Shamsuddin, Mario Garcia Podesta

Optimization of the utilisation of grassland/ranch land by livestock growers would benefit many millions of farmers in the World since 40.5 percent of the terrestrial area excluding Greenland and Antarctica Grasslands are covered by grasslands, which are important as feed source for livestock.

The project aims to develop a practical method to predict pasture intake of ruminants grazing heterogeneous pastures and rangeland using stable isotopes to provide tools for better grassland management that enhance animal productivity and reduces impact on environment due to overgrazing, and to allow the design of effective feed supplementation strategies at farm level to optimize animal production.

In the CRP are planned three major laboratory activities: (a) the analysis of concentrations and stable carbon isotope composition (delta13C values vs. VPDB - Vienna Pee Dee Belemnite) of n-alkanes in the plant and faecal samples to predict dry matter (DM) intake and its plant proportions; (b) the use of conventional chemical analysis of plants to determine their nutritional value; and (c) the development of the near infrared reflectance spectroscopy (NIRS) predictive equations of DM intake and the plant profile of that intake to facilitate the design of diets and supplements required to cover the nutritional needs of animals to optimise their productivity. The combination of the three technologies applied to plant and faecal samples obtained in a common research protocol used by all participating countries will allow reaching the scientific objectives of the CRP.

The project will run for five years. Seven research contract (RC) holders and 4 agreement holders are being selected. The first RCM will be held in January 2017.

The use of irradiated vaccines in the control of infectious transboundary diseases of livestock (D3.20.29)

Technical Officer: Hermann Unger, Gerrit Viljoen

Vaccination has been one of the greatest achievements of mankind in enabling the eradication of serious, life-threatening diseases of man and his domesticated livestock. Many of the vaccines used today rely on technologies developed over 100 years ago involving some form of attenuation, i.e. the use of an alternative or mutant strain of a pathogenic organism that has reduced virulence whilst maintaining immunogenicity, or inactivation, where chemical or physical methods are used to kill virulent pathogenic strains. In general, attenuated vaccines are more efficient than killed vaccines which might be denatured in their immunogenic sites and displaying a different recognition system of the immune system. Irradiation of pathogens may be an alternative to chemical inactivation of the pathogen for developing efficient vaccines.

This CRP which now ends, evaluated the irradiation doses for different pathogens to suppress amplification but keeping the pathogen metabolically active. This strategy allows for safety, i.e. the pathogen cannot multiply and thus not affect the host. Due to its low metabolic activity it is still recognized by the host immune system as a live organism, which for instance does invade cells. This mechanism activates the cellular immune system, recognizing 'infected' cells and leading to a memory effect which extends the time of immunity to often several years.

In the first phase of the project the most efficient dose of irradiation was evaluated. In the second phase the metabolic activity was determined. In the last phase the immunogenicity was evaluated in animals. Good results have been obtained with some cases such as, Theileria annulata, brucellosis and Fasciola gigantica. In those cases the evaluation in the natural host remains to be carried out. Such tests were already carried out for the fish parasite Ichthyophthirius multifilis and the ruminant gastro-intestinal parasite Haemonchus contortus. The results obtained so far are very promising with a 99% reduction in parasites after challenge and it is foreseen to continue with the H. contortus vaccine in the next CRP to evaluate the technical requirements facilitating the medium scale production of this novel irradiated vaccine.

Use of stable isotopes to trace bird migrations and molecular nuclear techniques to investigate the epidemiology and ecology of the highly pathogenic avian influenza (D3.20.30)

Technical Officer: Ivancho Naletoski, Gerrit Viljoen

Among several important issues in the epidemiology of highly pathogenic avian influenza (HPAI) that needs attention is the role that wild water fowl (WWF) populations might play in the dissemination of infection. Tracing the movements of WWF in relation to where they originated as well as their stopover points during their migration between breeding and non-breeding grounds is a particularly challenging task.

It is necessary to utilize methods that can be used on a larger scale and not biased to initial capture location if we are to fully comprehend the role of migratory birds in the spread of avian influenza. A suitable technique that has already been used to trace migrants is based on the stable isotope (SI) signatures of the tissues of birds, especially those in feathers. Of most interest are deuterium (δD) ratios in tissues that reflect those in surface (lakes, rivers, oceans) and ground waters. Since hydrogen isotope composition of environmental water varies spatially across the globe in a predictable manner, and its presence relayed to feathers, δD analyses of feathers provide a way of linking SI data on water isoscapes with those in the feathers.

Faecal samples will be used for the detection of AI viruses with extraction and analysis of somatic DNA to detect the bird species. These two techniques will be used to link the AI carrier status and the carrier species without even capturing the birds, and may thus be used as a non-invasive platform to generate important epidemiological information on migration pathways (obtained by SIA) and the transmission of the virus to a certain geographical area. Faecal samples should be collected randomly at the same sites where feathers are collected. Samples will undergo two test procedures:

(a) DNA barcoding (species identification) was adapted at the Avian Disease Laboratory, College of Veterinary Medicine, Konkuk University, South Korea. The technique is based on detection of a short gene sequence from a standardized region of the genome as a diagnostic 'biomarker' for species. The target sequence has been the 648-bp region of the mitochondrial gene, cytochrome C oxidase I (COI), already optimized as a DNA barcode for the identification of bird species. The optimization of a DNA barcoding technique for faecal samples has been performed by comparing DNA from the faecal samples with the DNA from tissue samples (muscle, feather, and blood) from already known bird species (domestic poultry and WWF), collected from live bird markets, the Conservation Genome Resource Bank for Korean Wildlife and from the Seoul Grand Park Zoo. The results of bird species identification, using COI gene sequences from tissues matched the faecal samples of the same individuals.

(b) Detection of AIV in the faecal samples using optimized protocol in five phases: i) detection of M gene to detect the presence of influenza A viruses using PCR technique (positive samples should be inoculated in SPF eggs for virus isolation), ii) positive samples should be tested using H5 or H7 protocol by PCR, iii) H5 and H7 positive samples should undergo molecular pathotyping (cleavage site sequencing), iv) M gene positive, H5 and H7 negative, should be further typed in order to differentiate the subtype using conventional (HI-test) and/or molecular methods, v) positive samples and a portion of negatives will be tested using loop mediated isothermal amplification (LAMP) protocol.

The main pathway of AIV transmission is faecal contamination. Natural water reservoirs are the media where WWF faeces are excreted in the water, contaminating it randomly. However, the survival of the AIV in natural water reservoirs depends on numerous environmental, physical and chemical influences, as well as on the period between excretion by an infected and infection of a healthy WWF. Testing of natural water reservoirs will generate information on the level of (eventual) contamination and the risk of AIV transmission via these media at different geographical and environmental conditions. Water samples should be collected from different points of each selected area, in an amount of approximately 500 ml per sample. Each sample should be tested for the presence of AIV, using PCR with previous concentration of the virus. Using a standardized protocol it is possible to quantitatively evaluate the level of contamination based on a comparison with a known titrated virus isolate.

Of great epidemiological interest would be the potential application of the same technology to trace short range migration in wildlife carriers, in order to determine their role in transmission of animal and/or human pathogens.

Seven research contract holders from Bulgaria, China, Egypt, Nepal, Russian Federation, Tajikistan and Turkey, two agreement holders from Germany, and three technical contract holders from Canada, Republic of Korea and the UK are currently participating in the CRP.

The first RCM was held at the IAEA from 31 October to 2 November 2012. The second RCM was held from 5 to 9 May 2014 in Izmir, Turkey. The third RCM will take place in Sofia, Bulgaria, from 31 October to 4 November 2016.

The early and rapid diagnosis and control of TADs – second phase – African swine fever (ASF) (D3.20.31)

Technical Officers: Herman Unger, Charles Lamien

This CRP started in 2014 and focuses on evaluating technologies which could help to control ASF worldwide.

African swine fever is a contagious viral disease of pigs transmitted by ticks or through contact. In domesticated pigs, it leads to acute disease with high mortality and survivors are chronically infected serving as the reservoir for further transmission. Wild boars are the natural reservoir in Africa. Endemic in wide parts of sub-Saharan Africa it has spread in the last 10 years to the Northern Caucasus and keeps expanding primarily to the West and North. The disease creates severe economic hardship for pig farmers and due to lack of a vaccine, culling and quarantine measures are the only tools available to control disease. As pig production is in many cases a small scale business, farmers often lack the means and education on

how to fend off disease. Even with the availability of diagnostic tools, a number of issues regarding its epidemiology or virology are not understood.

Under the CRP, a validation trial for the serological diagnostic ASF tests (ELISA based) has been completed and the contract holders will now begin testing molecular diagnostic tools to define the fitness of purpose for each available test. In parallel, samples from infected pigs, wild or domestic, will be collected for virus isolation. These isolates should be further characterized by sequencing to gain a better understanding of the genetic diversity on a spatial scale. This knowledge together with information regarding the pathology of each strain should allow some insight into the underlying pathogenic mechanisms and might help identify epitopes of interest for a candidate vaccine. Finally, a number of control measures will be initiated to see how efficient they are in the context of small scale commercial production. The first research coordination meeting took place from 7 to 11 July 2014 in Vienna, Austria. The second RCM took place from 20 to 24 June 2016 in Vienna, Austria.

Early detection of transboundary animal diseases (TADs) to facilitate prevention and control through a veterinary diagnostic laboratory network (VETLAB Network) (D3.20.32)

Technical officers: Ivancho Naletoski, Charles Lamien

The Veterinary Laboratory Network (VETLAB Network) currently integrates 32 African and 17 Asian MS which are dedicated to share knowledge and experience and support each other during the implementation of international standards, routine diagnostic procedures, sharing diagnostic approaches for specific disease outbreaks, thus facilitating the emergency preparedness and response to animal health emergencies. The concept of networking has proven its fitness for purpose during the rinderpest eradication campaign. Nowadays, this concept has resulted with great successes in some of the MS, where the diagnostic laboratories have received accreditation for the ISO 17025 standard. Additionally, several other laboratories in this network are in advanced phases of implementation of the standard and expect soon accreditation.

When transboundary disease events are likely to appear or have already appeared, regional laboratory preparedness is critical for the implementation of the complex, multi-sectorial disease responses. Therefore, the maintenance, strengthening and upgrade of the laboratory networks is of utmost importance for the planning and the start-up of proper contingency plans aimed to prevent and / or control the currently threatening diseases.

The VETLAB Network is a concept for the establishment of a unique regional / interregional communication and activity skeleton which enables for sustainable functioning and upgrade of the laboratories under internationally recognized principles.

Critical step for harmonization of the diagnostic techniques is the establishment of primary and/or secondary standards (as appropriate) which would use as reference during the calibration and maintenance of the diagnostic tests. The CRP will target establishment of such standards for use in serological and molecular diagnostic c techniques. The CRP will have to develop the following outputs:

1. A set of internationally acceptable standards for the serological diagnostic techniques for priority diseases among the partners of the VETLAB Network;
2. A set of internationally acceptable standards for the molecular diagnostic techniques for priority diseases among the partners of the VETLAB Network;
3. Procedures for simultaneous detection of multiple pathogens (multi-pathogen detection panels);
4. Procedure for easy access, free-of-charge genetic sequencing services for pathogens of the priority diseases among the partners of the VETLAB Network;
5. Establish an information platform for integrated information collection, geo-visualization, analysis and decision making.

Participation in the CRP:

• Institutions and scientists with experience in collection of serum samples in larger amounts (slaughterhouses, disease eradication).

• Institutions and scientists with experience in preparation of inactivated and calibrated pathogens for use in molecular assays.

The team will be comprised of 10 research contracts and 3 technical contracts. Scientists interested in participating in this CRP may contact the Project Officer at i.naletoski@iaea.org.

Planned CRPs

Irradiation of Transboundary animal disease (TAD) pathogens as vaccines and immune inducers

Technical officer: Hermann Unger

A new CRP on irradiated vaccines will be launched in 2016. The results of the previous CRP on the 'The Use of Irradiated Vaccines in the Control of Infectious Transboundary Diseases of Livestock' developed the basic understanding and procedures for irradiated vaccines and

should now be expanded from the lab scale to small scale production for field evaluation. This also includes immunology studies to observe the protective mechanisms involved. So far, very promising work was presented on Haemonchus contortus and Fasciola gigantica. Additionally, we will work on irradiated viruses as immune inducers, as the current vaccine adjuvants are rather unspecific and sometimes difficult to apply in existing vaccines. For more information please contact h.unger@iaea.org or see http://cra.iaea.org/cra/index.html.

Submission of Proposals

Research contract proposal forms can be obtained from the IAEA, the National Atomic Energy Commissions, UNDP offices or by contacting the Technical Officer. The form can also be downloaded from the URL:

http://cra.iaea.org/cra/index.html

Activities of the Animal Production and Health Laboratory

APHL staff.

Animal Genetics

Application of Nuclear and Genomic Tools to Enable for the Selection of Animals with Enhanced Productivity Traits

Genetic improvement of farm animals for increased productivity of milk, meat and fibre is traditionally based on selection and breeding of high performance animals. With the recent advances in genomics, it is now possible to estimate the breeding value of animals using genomic tools like DNA microarrays. Development of DNA microarrays for animal evaluation requires sequencing and mapping of the genome. Application of radioisotope technologies for mapping livestock genomes has been very successful and efficient, particularly in producing high resolution maps at relatively low cost and shorter time. Radiation hybrid panels and genomic tools are available only for few major livestock species including cattle, sheep, goat and pig. However, such tools are not available for many other agriculturally important species like zebu cattle, camel, alpaca, lama, yak, donkey, mithun, rabbits, etc., which thrive in extremes of hot, arid and high altitude cold regions, but contributing to the livelihood of large number of marginal farmers. For example, camels are important for several million nomadic pastoralists in Asia and Africa and the market demand for camel milk is fast increasing. Considering the significance of camel improvement, APHL initiated the construction of radiation hybrid panels for mapping the camel genome as part of the newly launched coordinated research project on Application of nuclear and genomic tools to enable for the selection of animals with enhanced productivity traits.

Construction of radiation hybrid panels to map camel the camel genome

A normal diploid fibroblast culture (CDR-2) from a male dromedary camel established in the Equine Genetic Laboratory, Department of Animal Sciences, University of Florida, USA was used as the donor cell line. The donor cells were fused with a recipient thymidine kinase-deficient hamster cell line (A23) after irradiation at a dosage of 150 Gy (15 000 rad). A total of 238 camel–hamster radiation hybrid clones were collected, of which 98 have been expanded to increase the cell population for DNA extraction. Preliminary screening of hybrid clones for the retention of camel DNA is currently ongoing with an initial set of 48 markers that are distributed across the genome.

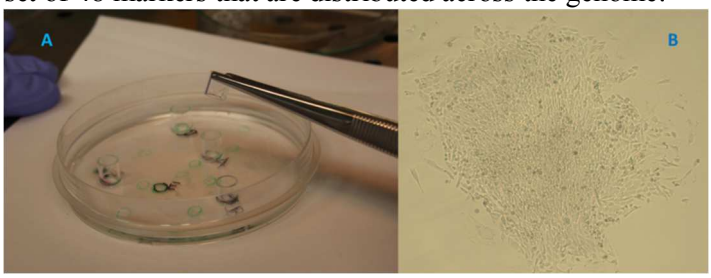

Figure 1. (A) Isolation of individual colonies for clone pick up (B) Individual camel–hamster hybrid colony.

In addition to 15 000 rad panel, a second panel with an irradiation dose of 5000 rad will be generated to improve the integrity of chromosome assembly of the camel genome. The fibroblast cells from a female dromedary camel, the genome of which had been sequenced already by Camel Genome Group of the Veterinary Medical University; Vienna, Austria will be used as the donor cell line. The development of whole genome radiation hybrid panels for camels will provide a fundamental tool for advanced genome mapping and subsequent development of genetic tools for camel improvement.

Support to the Member States for implementation of Global Plan of Action on animal genetic resources (AnGR)

In continuation of Agency's support in implementing the Global Plan of Action on animal genetic resources (GPA-AnGR), APHL supported genetic characterization of native cattle from Burkina Faso and Niger. One fellow, Mr Moumouni Sanou from Burkina Faso, was trained on molecular genetic characterization of cattle breeds using nuclear and extra-nuclear DNA markers.

Genetic characterization of indigenous cattle breeds of Burkina Faso and Niger

Most of the indigenous cattle from Burkina Faso and Niger are compact and low milk producers except for few moderately producing cattle breeds like Azawak and Goudali. Most of these animals survive on naturally available grasses (e.g. Penicetum) and crop residues and are well adapted to tropical environment. However, much required information on genetic potential of these animals like genetic variability, level of inbreeding, physical and phenotypic characteristics are lacking. A total of 286 samples collected from two major cattle breeds of Burkina Faso and eight cattle breeds of Niger were analysed by sequencing control region (D-loop) of mitochondrial genome. All the animals were also genotyped at 27 microsatellite marker loci grouped in six multiplex panels. The extraction of genotype data and analysis of mitochondrial DNA sequences are currently under progress.

Figure 2. (A) herd of indigenous cattle in Burkina under extensive management system (B) Zebu Peuhl cattle (C) Goudali cattle (D) Azawak cattle.

Animal Health

APHL technical support to the global eradication of Peste des petits ruminants (PPR)

New serology-based test diagnostic for PPR

A new diagnostic test for rapid detection of PPR in serum samples has been recently developed by APHL. The test called PPR-LIPS (luciferase immunoprecipitation system) is based on luminescence and since it maintains the conformational structure of the proteins involved, it is capable of identifying PPR antibodies from related rinderpest antibodies without cross-reactivity. The PPR-LIPS test is high sensitivity and specificity and unlike the currently marketed ELISA tests, shows no cross-reactivity to rinderpest or other common small ruminants virus pathogens. The test also works across species and requires only 1ul of serum per reaction.

APHL is currently working on the optimization of the reaction conditions to transfer this new assay, a good candidate for the specific sero-surveillance of PPR, to Member States in late 2016.

Characterization of Newcastle disease viruses isolated from commercial poultry in Mozambique (2011 to 2016)

Newcastle disease (ND) is a deadly viral disease of chickens and one of the main limiting factors for the development of sustainable poultry economy in several developing countries.

Like in many African countries, Newcastle disease has evolved into a major health issue for both rural and commercial poultry production in Mozambique and is responsible for high mortalities in these sectors annually. A molecular epidemiological investigation of ND viruses isolated from commercial poultry in Mozambique between 2011 and 2016 and collected by the Central Veterinary Laboratory, Maputo was undertaken as part of a capacity building programme funded by the IAEA Peaceful Uses Initiative (PUI), African Renaissance project (ARF) and technical cooperation project MOZ5005.

Eleven NDV isolates were analysed in total and the results clearly showed that the viruses belonged to the genotype VII group of viruses which is one of the predominant groups of virulent NDVs circulating globally (Figure 3). More specifically, the NDVs from Mozambique clustered with viruses from South Africa, China, Malaysia and Indonesia and were significantly different from other NDVs previously described in Mozambique in 1994, 1995 and 2005. The characterization of these new NDVs has

important implications for ND management and control in Mozambique. As a result, the reassessment of key processes and requirements for vaccination against ND in commercial poultry in Mozambique may, therefore, be necessary.

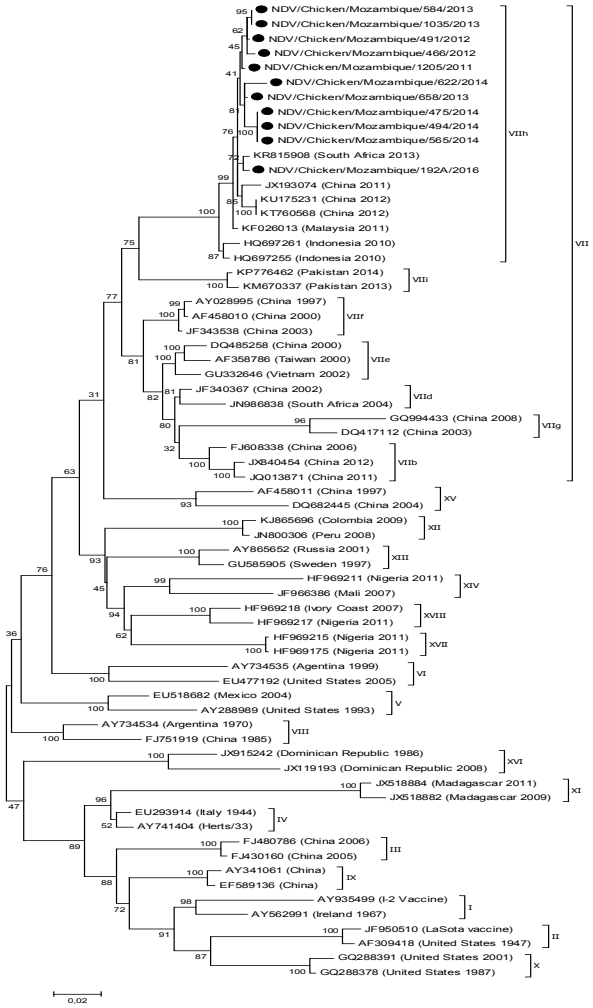

Figure 3 : ML analysis using the MEGA6 software of the full F gene nucleotide sequence (1662 bp) from eleven NDV positive samples from Mozambique (filled circles). The numbers indicate the bootstrap values calculated from 500 bootstrap replicates.

2016 PPR Proficiency Test

The proficiency test is an extremely valuable exercise for Member States' laboratories to evaluate and maintain their capacity to diagnose this important disease affecting small ruminants in vast areas of the world. APHL has organized a PPR proficiency test for the serological and PCR based detection of PPR. The testing panel is planned to be shipped to the participating laboratory in summer 2016. Twenty-eight laboratories were invited to the exercise; sample results will be evaluated individually and confidentially. Also an anonymous summary of the results will be provided at the end of the exercise and the APHL staff will work in close connection with MS' laboratories to evaluate results and troubleshooting.

Laboratory activities to support Member States in controlling lumpy Skin Disease

Lumpy skin disease (LSD) is affecting cattle and is caused by a capripox virus endemic in the cattle population of several countries in Asia and Africa. The virus is genetically related to the capripox viruses affecting sheep and goats, namely sheeppox virus (SPPV) and goatpox virus (GTPV). Europe was considered LSD free, with only recent sporadic reports of SPPV and GTPV in the South East of the continent. In recent years the disease became endemic or spread in EU neighboring countries, such as Turkey and Russia and in 2015 it was for the first time reported within the EU borders, in Greece. In April 2016, the disease was reported for the first time in Bulgaria and the Former Yugoslavian Republic of Macedonia (FYROM).

APHL has been conducting several R&D and capacity building activities on LSD and related capripox viruses since long time and was able to immediately react to the emergency request for support made by the Government of Bulgaria and implemented emergency response activities for Bulgaria, FYROM and neighboring countries at risk. With the support and contributions of the whole APHS and TC Europe, the activities included rapid deployment of laboratory experts for a field assessment mission in Bulgaria, preparation and shipment of laboratory reagents and material needed to detect and control the infection (emergency tool kits), revision, update and distribution of three standard operating procedures (SOPs) for laboratory virus detection, preparation and distribution of non-infectious positive controls necessary for test standardization, organization of laboratory trainings in the IAEA laboratories in Seibersdorf for affected and at-risk countries on advanced laboratory diagnoses of the poxvirus infections.

Concerning the R&D activities with specific focus on LSD and other capripox viruses, APHL has developed and validated nuclear-derived, PCR-based tests for the detection and genotyping of capripox. These tests can be performed on real time PCR platforms available in MS and enable a very rapid (a couple of hours) discrimination between LSDV, SPPV and GTPV. The results obtained by this assay can be further confirmed by other protocols developed in APHL based on traditional PCR (gel-based) and genetic sequencing. The latter allows for a more precise characterization of the virus strain involved and detailed molecular epidemiology investigations. These validated procedures are going to be standardised in SOPs and distributed to MS.

To date, rapid and simple serological tests for capripox virus screening of susceptible population are not available. These types of tests would be extremely valuable for monitoring disease-free areas, post-vaccination surveillance

and epidemiological studies. APHL is currently working on the evaluation of prototype serological assays which can be transferred to MS.

Identification of a new genotype of African swine fever virus in domestic pigs from Ethiopia

African swine fever (ASF) continues to be a disease of economic importance affecting many of our Member States. We have continued to work closely with several Member States in Africa to expand our knowledge on the molecular epidemiology of ASF virus (ASFV). Recently, in collaboration with Ethiopia and Spain, we have published a journal article describing a new, unique strain of ASFV that is currently circulating in Ethiopia. This new strain is distinctly different from the previously defined 22 genotypes of ASFV and is designated as a new genotype, XXIII. In order to place the ASF viruses sequenced in one of the 22 p72 genotypes as so far described, the sequences obtained were compared with homologous sequence representatives of each p72 described genotypes. A minimum evolution tree (Figure 4) mapped the eleven ASFV Ethiopia isolates in a new p72 genotype, named genotype XXIII, with a high bootstrap value (95%). Genotype XXIII shares a common ancestor with genotypes IX and X which contain East African isolates from Kenya, Uganda, Burundi and Tanzania and the Central African ASFV isolate from the Republic of Congo.

The nature of the new genotype discovered was confirmed through the amplification of the tetrameric repeat sequences within the central variable region (CVR) of the B602L gene. Sequence analyses resulted in the identification of three different variants among the ASFV Ethiopia viruses. The CVR variants 1 and 2 were characterized by the presence of 3 different types of amino acid tetramers (J=GTDT; K = CTSP; L= YTNT) not previously characterized.

As the domestic population of swine in Africa continues to grow, so does the problematic economic constraints when there is no vaccine and the only form of control is stamping out of infected pigs. This makes the need for a vaccine more imperative than ever to control this transboundary animal disease. While the detection of ASFV in Ethiopia is more recent than other East African countries, the detection of a completely different genotype leaves a gap in understanding the epidemiology of the virus. The knowledge that the virus was also detected in apparently healthy animals from an abattoir also emphasizes the need for continued surveillance. It is important for us to better understand the epidemiology of the virus so that a future vaccine can be prepared that protects domestic swine from future outbreaks.

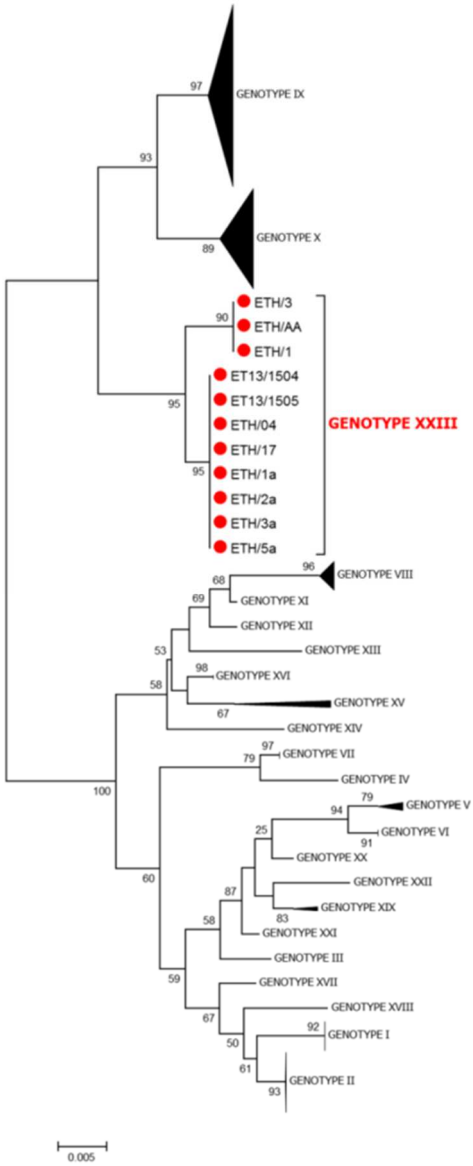

Figure 4. Minimum evolution phylogenetic tree of the Ethiopia ASFV isolates based on the analysis of the 405 nucleotides situated at the C-terminal end of the p72 coding gene relative to the 22 p72 genotypes (labelled I–XXII), including 234 nucleotide sequences. The tree was inferred using the minimum evolution (ME) method following initial application of a neighbour-joining algorithm. The evolutionary distances were computed using the p-distance method and are in the units of the number of base differences per site. The percentage of replicate trees >50% in which the associated taxa clustered together by bootstrap analysis (1000 replicates) is shown adjacent to the nodes. The robustness of the ME tree was tested using the close-neighbour-interchange (CNI) algorithm at a search level of 1. ASFV Ethiopia isolates genotyped in this study are marked in red within the genotype XXIII.

Irradiation of pathogens are used to generate vaccine candidates — potential applications on animal trypanosomosis

Many studies have shown that irradiation can cause pathogens to lose their ability to provoke disease yet remain metabolically active due to the repression of replicative and virulent functions. The use of irradiated pathogens as vaccine candidates has been exploited in

several infections and indeed provided protection from diseases. With the recent development of an irradiated vaccine against malaria, the possibility of developing an irradiated vaccine against trypanosome parasites has been explored using new methodologies. Trypanosomes cause a devastating chronic disease in livestock and account for the loss of billions of US$ to small holder farmers and pastoralist communities especially in Africa. There are no vaccines available for any of the diseases caused by the different species of trypanosomes in livestock although various approaches to develop a vaccine have been investigated. APHL has initiated a vaccine development program utilizing irradiation attenuated parasites as the vaccine candidate. Studies have shown that using a dose of 200Gy does not kill the parasites but halts their ability to cause an infection in mice. Ongoing studies on the effect of irradiation in trypanosomes using flow cytometry have been pursued to further characterize their cellular level activities. These studies have yielded three important discoveries:

A) Irradiation produces three distinct phenotypes in parasites: dead/apoptotic, living and a third population that displays dim staining of an amine reactive dye (Figure 5).

B) Irradiation with 200Gy, which has been established as the dose that does not cause infection in the host, still allows the parasite to replicate at a lower rate indicating that certain virulent factors are supressed during irradiation (Figure 5).

C) Using GFP knock-in parasites we show that parasites irradiated using 200Gy are still able to express proteins (Figure 5).

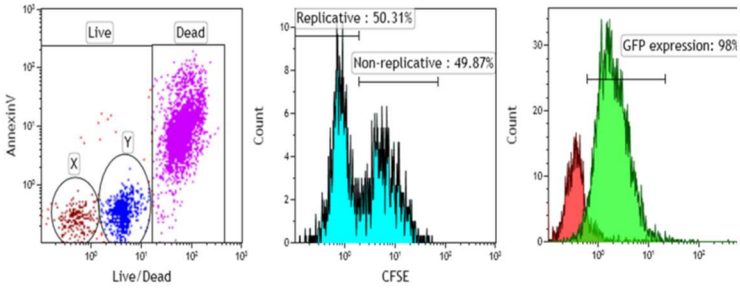

Figure 5: Functional and phenotypic characteristics of Trypansoma evasi following irradiation with 200Gy and cultured for 24 hours. A) Two populations of live and dead parasite scan be differentiated based on the amine reactive dye and annex in V binding. The live population is further divided into two (X and Y) populations based on the amine reactive dye. B) Parasites were pulsed with CFSE dye, the live cell population is shown based on the CFSE expression. C) GFP knock-in parasites (green) and wild type parasites (red) are shown after gating on the live cell population following irradiation using 200Gy.

Fellows/interns/consultants

Ms Ibtisam Amin Sidahmed Goreish from Department of Parasitology, Central Veterinary Research Laboratory, Khartoum, Sudan, was on a scientific visit and trained on evaluating cellular immune responses following vaccinations at APHL for two weeks (11–22 January 2016) under the TC project SUD5036.

Ms Mihad Fath El Rahman Alawad from Veterinary Research Institute (VRI), Animal Resources Research, Corporation (ARRC), Ministry of Livestock, Fisheries and Rangelands, Sudan, was on a fellowship to be trained on flow cytometry and ELISA based technologies in evaluating cellular immune responses following vaccinations at APHL for two months (11 January–11 March 2016) under the TC project SUD5036.

Mr Moumouni Sanou from Département Productions Animales, Institut de l'Environnement et de Recherches Agricoles (INERA), Ouagadougou, Burkina Faso was trained on 'Molecular genetic characterization of native cattle breeds using nuclear and extra-nuclear DNA markers' at APHL for two months (23 February–22 April 2016) under TC fellowship (BKF5017).

Mr Georgi Stoimenov from University of Forestry, Sofia, Bulgaria joined APHL as consultant to work on 'DNA Barcoding of wild birds to trace avian influenza carriers' for three months (from 1 December 2015 to 29 February 2016).

Field support missions

1. Technical visit to State Central Veterinary Laboratory (SCVL), Ulaanbaatar, Mongolia

As a part of Peaceful Uses Initiative (PUI) project, SCVL from Mongolia requested a field support mission. An expert from APHL visited SCVL, Ulaanbaatar from 1 to 5 December 2015. The multiplex assays for detection of pathogens causing red diseases in swine (African swine fever, classical swine fever, Salmonella and Erysipelas) and respiratory diseases in small ruminants, developed at APHL, were successfully transferred to the laboratory. Six staff members from SCVL were provided hands on training on the above techniques along with sequence data analysis. The staff from SCVL was able to perform the multiplex assay and analyse the real time PCR data obtaining very good results. The team expressed their satisfaction and gain confidence in sequencing data analysis followed by submission to genetic databases. SCVL showed interest to contribute in future for the method validation at their laboratory. It is expected the acquired knowledge will improve SCVL's contributions to Mongolia's efforts in controlling TADs affecting sheep, goat, pigs and camels.

2. Field support mission to Ouagadougou, Burkina Faso

The mission was carried out to support the national efforts to put in place a sustainable native cattle breeding system for Burkina Faso utilizing indigenous artificial

insemination services and supported by modern animal genetics tools through the IAEA technical cooperation project (BKF5017). The aims of this mission were: (1) to identify appropriate native cattle breed suitable to small holder farmers and establish a cattle breeding objective with the national artificial insemination centre as the focal point; (2) to identify the logistics requirements to improve the operational efficiency of AI centre; (3) to transfer the real time PCR based animal genotyping methodologies; and (4) to train the animal geneticists/breeders from Burkina Faso, Niger and Mali on genotyping workflow and analysis of molecular genetic data for characterization of native cattle breeds. During the week, a field visit was made to small holder cattle farms under extensive management system to identify the breeding requirements of farmers and assess their willingness to adopt artificial insemination for dairy cattle breeding. The farmers were highly interested in superior genetic merit animals that produce better milk, for example breeds like Azawak that can produce moderately high milk but well adapted to local conditions.

It was agreed with the authorities of INERA and Ministry of Animal Resources that the AI centre will focus on improving the production of frozen semen from Azawak bulls that can be distributed to small holder farmers at a nominal cost. The requirements of the AI centre to improve the scale of production were identified and technical guidance was provided to the staff on collection of performance data from bull mothers and selection of bulls for semen production. The training on genotyping workflow and analysis of molecular genetic data was attended by 13 participants from INERA (Burkina Faso), University of Koudougou (Burkina Faso), University of Dédougou (Burkina Faso), University of Taoua (Niger), Abdou Moumouni University (Niger), Ministry of Animal

Resources and Fisheries (Niger), Research and Training Institute (Mali). The participants were provided hands on practical training to utilize different bioinformatics software for analysis of DNA marker data to assess the genetic diversity and population structure. It is expected that the training will help the ongoing national efforts to complete the genetic characterization of native livestock breeds in Burkina Faso and Niger.

Figure 6. (A) Training participants discussing the work flow of animal genotyping (B) Hands on practice on molecular genetic techniques (C) Participants working on genotype data analysis (D) All training participants.

Technical Cooperation Projects

TC Project	Description	Technical Officer(s)
ALG/5/027	Strengthening Animal Health and Livestock Production to Improve Diagnostic and Reproductive Capacities in Animal Breeding and Support Expertise for the Feasibility Study of a Biosafety Laboratory, Level 3 (BSL3) **Objective:** To contribute to the improvement of animal health and livestock production by using nuclear and nuclear related technologies to strengthen reproductive and diagnostic capacities in animal breeding, to support expertise for the feasibility study of a biosafety laboratory.	M. Shamsuddin I. Naletoski C. Lamien
ANG/5/013	Applying Nuclear and Molecular Techniques for Diagnosis and Control of Transboundary Animal Diseases **Objective:** To support veterinary services in the control of transboundary animal diseases.	G. Viljoen I. Naletoski

TC Project	Description	Technical Officer(s)
BDI/0/001	Supporting Human Resource Development and Nuclear Technology Support including Radiation Safety O**bjective**: To upgrade and strengthen the skills and capabilities of human resources and to provide general support within the broad spectrum of the application of nuclear science and technology, including radiation safety. To support unforeseen relevant needs of Member States.	I. Naletoski
BEN/5/007	Soil, Crop and Livestock Integration for Sustainable Agriculture Development Through the Establishment of a National Laboratory Network **Objective:** An interdisciplinary project that aims at a sustainable intensification of peri-urban agricultural production through the integration of cropping-livestock systems was developed.	M. Shamsuddin H. Unger
BEN/5/010	Using Nuclear Techniques for Better Utilization of Local Feed Resources and Improved Reproduction Practices to Enhance Productivity and Conserve Nature **Objective:** To improve livestock productivity by using crop residue-based feedings and better practices of animal reproduction.	M. Shamsuddin
BGD/5/030	Building Capacity to Improve Dairy Cows Using Molecular and Nuclear Techniques **Objective:** To improve the productivity, health and reproduction of dairy cows using molecular and nuclear techniques.	M. Shamsuddin G. Viljoen
BKF/5/014	Improving the Productivity of Small Ruminants through Diet, Health and Identification of Genetic Markers for Selection and Breeding Management **Objective**: To contribute to improving the productivity and profitability of small ruminant farms in Burkina Faso by applying genetic characterization and artificial insemination for breeding and utilizing local feed resources to improve nutrition and medicinal plants to control parasites	M. Garcia Podesta M. Shamsuddin K. Periasamy
BKF/5/015	Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique **Objective**: To support the national and regional efforts to combat HPAI H5N1 outbreak in Burkina Faso	H. Unger I. Naletoski
BKF/5/017	Using Modern Animal Breeding Methods, Nuclear and Genomic Tools to Improve Dairy Production in Smallholder Production Systems **Objective**: To improve the productivity of cattle through the application of genetic characterization, artificial insemination and control of zoonotic diseases.	K. Periasamy M. Shamsuddin
BOT/5/015	Establishing District Laboratories that use Nuclear and Molecular Techniques for Early and Rapid Diagnosis of Endemic and Transboundary Animal Diseases **Objective**: To improve diagnostic capacity of transboundary animal diseases like FMD, PPR, ASF, RVF and endemic diseases like vector borne diseases, clostridial diseases, anthrax, and reproductive diseases through establishment of district laboratories, where nuclear molecular diagnostic techniques will be used.	G. Vljoen C. Lamien
BZE/5/007	Supporting Sustainable Capacity Building through Distance Learning for Laboratory Personnel of the National Agricultural Health Authority **Objective**: To increase and sustain the level of trained qualified staff in the laboratory, and thus the sustainability of the laboratory as a whole by providing an avenue for technical laboratory staff to pursue educational advancement while retaining their services.	G. Viljoen

TC Project	Description	Technical Officer(s)
CAF/5/009	Controlling Contagious Bovine Pleuropneumonia and Peste des Petit Ruminants **Objective:** To contribute to food security through improved animal health and production.	H. Unger
CHD/5/005	Studying the Causes of Pulmonary Diseases in Small Ruminants **Objective:** To contribute to poverty reduction and ensure the population's food security by increasing livestock productivity.	H. Unger C. Lamien
CMR/5/019	Using Nuclear Techniques to Improve Milk Production **Objective**: To improve breeding and disease control in cattle for increased milk production in Cameroon by utilising nuclear techniques.	M. Garcia Podesta M. Shamsuddin H. Unger K. Periasamy
ELS/5/012	Optimizing Livestock Production Systems through Cultivation and Efficient Use of Local Feed Resources, Monitoring of Performance and Reduction of Environmental Pollution through Solid Waste and Biogas Utilization **Objective:** To improve productivity of dairy cattle by using improved forage-based feeding systems, reproductive practices and generation of energy from manure while reducing greenhouse gas emissions.	M. Shamsuddin I. Naletoski
ERI/5/009	Enhancing Small Scale Market Oriented Dairy Production and Safety for Dairy Products through Improved Feeding and Cattle Management, Higher Conception Rates and Lower Calf Mortality **Objective:** To increase dairy production through improved feeding and cattle management and higher conception rate and lower calf mortality, and improve farmers' livelihood in Eritrea.	M. Shamsuddin
ETH/5/020	Enhancing the Livelihood of Rural Communities through Addressing Major Zoonotic and Economically Important Small Ruminant Diseases **Objective:** To investigate and control major small ruminant and zoonotic diseases in Ethiopia.	H. Unger C. Lamien
GHA/5/035	Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique **Objective:** To support the national and regional efforts to combat HPAI H5N1 outbreak in Ghana.	H. Unger I. Naletoski
INT/5/155	Sharing Knowledge on the Sterile Insect and Related Techniques for the Integrated Area-Wide Management of Insect Pests and Human Disease Vectors **Objective:** To share expertise and build capacity in control strategies against dengue and malaria vectors, to reduce the impact on human health and help Member States to meet their development goals.	I. Naletoski
IVC/5/034	Monitoring Epidemiology of Transboundary Animal Diseases **Objective**: To contribute to the fight against peste des petits ruminants (PPR). To allow for a systematic study and characterization of the viral strains present in Côte d'Ivoire. To help improve the economic situation of small-scale farmers, who have suffered in the crisis. The results from the epidemiological study planned under the project, and of the economic study to be conducted, will be key tools in this post-crisis phase.	H. Unger

TC Project	Description	Technical Officer(s)
IVC/5/037	Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique **Objective**: To support the national and regional efforts to combat HPAI H5N1 outbreak in Cote d'Ivoire.	I. Naletoski H. Unger
IVC/5/038	Studying Small Ruminant Respiratory Diseases **Objective**: To understand complex respiratory syndrome in small ruminants by identifying the various factors involved in the different seasons, with a view to improving strategies for their control	H. Unger G. Viljoen
KAM/5/002	Using Nuclear and Molecular Techniques to Improve Animal Productivity and Control Transboundary Animal Diseases **Objective:** To improve livestock productivity for food security by integrated management of animal nutrition, reproduction and health which includes: early pregnancy diagnosis for better reproductive management, metabolic profiles in livestock for assessing nutrition.	G. Viljoen M. Garcia Podesta M. Shamsuddin
KAM/5/003	Supporting Sustainable Livestock Production **Objective:** To improve animal production through applications of modern breeding technologies and improved feeding.	M. Shamsuddin M. Garcia
KEN/5/033	Using an Integrated Approach towards Sustainable Livestock Health and Nutrition to Improve Their Production and Productivity for Enhanced Economic Development **Objective:** To use an integrated approach to manage both livestock health and nutrition in order to improve their production and productivity for enhanced economic development.	M. Shamsuddin
LAO/5/003	Using Nuclear and Molecular Techniques for Early and Rapid Diagnosis and Control of Transboundary Animal Diseases in Livestock **Objective:** To ensure quick and reliable test techniques for the detection of the animal disease pathogen to support the early warning and effective control and prevention of transboundary animal disease.	G. Viljoen
LES/5/003	Using Nuclear and Molecular Techniques for Improving Animal Productivity **Objective:** To improve livestock production.	G. Viljoen
LES/5/006	Enhancing Animal Production and the Health of Sheep and Goats in Lesotho **Objective:** To improve the efficiency of animal health and reproductive management of sheep and goats.	G. Viljoen
MAG/5/020	Improving Stockbreeding Productivity Through the Application of Nuclear and Related Techniques for Reducing Rural Poverty **Objective:** To contribute to reducing rural poverty by improving the productivity of stockbreeding.	M. Shamsuddin I. Naletoski
MAG/5/024	Applying Nuclear and DNA-Based Techniques to Improve Productivity of Local Livestock **Objective:** To contribute to increase productivity of livestock by 25% by means of sustainable improvement of indigenous and locally adapted cattle through genetic characterization, selection and multiplication of superior germplasm through an efficient artificial insemination programme.	M. Shamsuddin K. Periasamy
MAR/5/025	Improving the Productivity of Dairy Cattle through On-Farm Application of Achieved Research Information on Feeding Practices **Objective:** To enhance productivity of smallholder dairy farming through improved reproduction practices and better feeding with locally available forage and browse species.	Ms. Shamsuddin

TC Project	Description	Technical Officer(s)
MAU/5/004	Supporting Genetic Improvement of Local Cattle Breeds and Strengthening the Control of Cross-Border Diseases **Objective**: To increase livestock productivity by reducing disease events and improving breeding programmes and genetic resources for food security.	H. Unger M. Shamsuddin
MLI/5/025	Improving National Capacities to Characterize Serotypes of Major Animal Diseases Using Molecular Biology Techniques for the Development of a National Disease Control Strategy **Objective**: The main objective is identification of the various serotypes of the foot and mouth disease virus. The project would help the elaboration of a national strategy for control of the disease by formulating vaccines which are currently imported from Botswana.	I. Naletoski C. Lamien
MLI/5/026	Improving the Diagnosis of Livestock Diseases **Objective:** To improve animal health by implementing a control programme to tackle the major prevalent animal diseases in Mali.	I. Naletoski C. Lamien
MLI/5/027	Using Nuclear and Molecular Techniques for Early and Rapid Diagnosis, Epidemiological Surveillance and Control of Transboundary Animal Diseases **Objective:** To reduce TAD impact on the development of the livestock sector in Mali.	I. Naletoski C. Lamien
MLW/5/002	Strengthening Capacity for the Diagnosis, Prevention and Control of Animal Diseases of Public Health Importance **Objective:** To establish nuclear related diagnostic systems and tools (serological and molecular) for the screening and rapid diagnosis (both field and laboratory) of important animal diseases for veterinary public health.	H. Unger
MNE/5003	Improving Diagnosis of Animal Diseases and Food Pathogens **Objective:** To improve the response to animal health and food safety challenges in Montenegro.	I. Naletoski
MON/5/020	Improving the Health Status of Livestock by Developing a Technology to Produce the Vaccine and Diagnostic Kit for Transboundary Animal Diseases **Objective:** To improve the health status of livestock by developing a technology to produce the vaccine and diagnostic kit of transboundary animal diseases.	H. Unger G. Viljoen
MON/5/021	Improving the Productivity and Sustainability of Farms Using Nuclear Techniques in Combination with Molecular Marker Technology **Objective:** To improve the productivity and sustainability of livestock and crop integrated farms through utilization of high yield, disease resistant new wheat varieties and other cereal varieties developed by the combined application of nuclear and molecular marker.	M. Shamsuddin
MON/5/022	Implementing Early Diagnosis and Rapid Control of Transboundary Animal Diseases, Including Foot-and-Mouth disease (FMD) and Peste des Petits Ruminants (PPR) **Objective:** To enhance early and rapid diagnosis of Transboundary animal diseases, including FMD and PPR.	H. Unger G. Viljoen
MOR/5/034	Improving Veterinary Drug Residue Detection and Animal Disease Diagnosis with Nuclear and Molecular Techniques **Objective**: To establish technical expertise using nuclear and complimentary non-nuclear techniques for screening and confirmatory analysis of veterinary drug residues and related chemical contaminants in food for human consumption and diagnosis of animal diseases by molecular biology.	I. Naletoski

TC Project	Description	Technical Officer(s)
MOZ/5/005	Strengthening the Sustainability of the Institution to Address Animal Diseases, Prevention, Food Safety and Animal Production Problems through Nuclear and Related Techniques **Objective:** To improve the productivity and sustainability of livestock and crop integrated farms through utilization of high yield, disease resistant new wheat varieties and other cereal varieties developed by the combined application of nuclear and molecular marker.	G.Viljoen
MYA/5/024	Supporting the National Foot-and-Mouth Disease Control Programme **Objective:** To increase productivity of the livestock sector by implementing sustainable strategies to control and eradicate Foot-and-Mouth Disease.	G. Viljoen
MYA/5/026	Improving the Livelihoods of Smallholder Livestock Farmers by Developing Animal Feeding Strategies for Enhanced Food Security **Objective:** To enhance food security through the utilization of local feed resources and develop the potential for the balancing ration leading to methane emission from enteric fermentation.	M. Shamsuddin
NEP/5/002	Improving Animal Productivity and Control of Transboundary Animal Diseases Using Nuclear and Molecular Techniques **Objective:** To improve livestock productivity for food security by integrated management of animal nutrition, reproduction and health.	G. Viljoen I. Naletoski
NEP/5/004	Improving Animal Productivity and Control of Transboundary Animal Diseases using Nuclear and Molecular Techniques: Phase II **Objective:** To improve food security by integrated management of animal nutrition, reproduction and health	I. Naletoski
NER/5/016	Strengthening the Capacities of the Epidemiological Surveillance Network for Transboundary Animal Diseases of Livestock **Objective**: To contribute to ensuring food security and to reducing poverty by improving livestock productivity through mitigation of health constraints.	I. Naletoski
NER/5/018	Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique **Objective**: To support the national and regional efforts to combat HPAI H5N1 outbreak in Niger.	H. Unger I. Naletoski
NIC/5/008	Improving Technical Capabilities for Detection of Diseases and Residues in Agriculture **Objective**: To improve capacity in detection of diseases and residues in animal and plant commodities for food trade.	G. Viljoen
NIR/5/038	Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique **Objective:** To support the national and regional efforts to combat HPAI H5N1 outbreaks in Nigeria.	I. Naletoski, H. Unger
NIR/5/040	Controlling Parasitic and Transboundary Animal Diseases to Improve Animal Productivity in Smallholder Farms Using Nuclear and Molecular Techniques **Objective**: To improve the livelihood of smallholder farmers in the country.	I. Naletoski,
PAK/5/050	Developing a Facility for the Diagnosis of Transboundary Animal Diseases and Vaccine Production **Objective**: To improve livestock productivity through the control of transboundary animal diseases in Pakistan.	H. Unger, V. Wijewardana

TC Project	Description	Technical Officer(s)
PAL/5/007	Upgrading Animal Feeding Laboratory in Terms of Human Capacity Building and Infrastructure **Objective**: To benefit livestock farmers by helping them to improve productivity by assuring them of certified quality animal feeds.	I. Naletoski, M. Shamsuddin
PAP/5/002	Genetically Characterising and Improving Productivity of Cattle by Enhanced Reproduction and Better Feeding **Objective**: To improve productivity of cattle by genetic characterisation for enhanced reproductive efficiency and better feeding.	K. Periasamy, M. Shamsuddin
RAF/0/042	Promoting the Sustainability and Networking of National Nuclear Institutions for Development **Objective**: To enhance the self-reliance and sustainability of national nuclear institutions and other end users of nuclear techniques in African Member States through the rationalization of scientific programmes and managerial practices.	I. Naletoski
RAF/5/068	Improving Livestock Productivity through Strengthened Transboundary Animal Disease Control using Nuclear Technologies to Promote Food Security (AFRA) **Objective**: To integrate livestock disease control in support of increased livestock productivity to enhance food security. To use an integrated approach while deploying available appropriate technologies to bring about sustainable improvement of livestock production among AFRA Member States. This will contribute to food security and poverty reduction, especially among small-holder farmers.	H. Unger C. Lamien
RAF/5/073	Strengthening Africa's Regional Capacity for Diagnosis of Emerging or Re-emerging Zoonotic Diseases, including Ebola Virus Disease (EVD), and Establishing Early Warning Systems. **Objective**: To enhance control of emerging zoonotic diseases in the African region, through safe and accurate early detection of pathogens in wildlife and livestock.	H. Unger I. Naletoski
RAS/5/060	Supporting Early Warning, Response and Control of Transboundary Animal Diseases **Objective:** To establish a regional/national network of laboratories and training centres on early diagnosis, response and control of transboundary animal diseases and eradication programmes for zoonotic diseases.	H. Unger
RAS/5/069	Complementing Conventional Approaches with Nuclear Techniques towards Flood Risk Mitigation and Post-Flood Rehabilitation Efforts in Asia **Objective**: To improve the capacity to develop resilience/adaptation of agricultural production systems to flooding events.	G. Viljoen / I. Naletoski C. Lamien
RER/9/137	Enhancing National Capabilities for Response to Nuclear and Radiological Emergencies **Objective**: To enhance Member States' capabilities to prepare for and respond to radiation emergencies, including a special emphasis on enhancing food security and safety by improving veterinary authorities participation in the national coordination mechanism.	I. Naletoski
RLA/5/071	Decreasing the Parasite Infestation Rate of Sheep (ARCAL CXLIV) **Objective**: To contribute to the sustainable increase in sheep production at the national and regional level.	M. Shamsuddin

TC Project	Description	Technical Officer(s)
SEN/5/036	Controlling Mycoplasma Mycoides Infection — Contagious Bovine Pleuropneumonia (CBPP) and Contagious Caprine Pleuropneumonia (CCPP) **Objective**: To contribute to the enhancement of livestock production in Senegal.	H. Unger
SEY/5/008	Building Capacity for Diagnosis of Animal Diseases using Nuclear and related Techniques (Phase I) **Objective**: To enhance local production of livestock in order to improve local food and nutrition security by reducing the country`s dependence on importation of animal and animal products.	H. Unger G. Viljoen
SIL/5/013	Establishing a Dual-Purpose Cattle Development Project for the Sustainable Contribution to Food Security, Poverty Alleviation and Improved Livelihoods of Communities Raising Cattle **Objective:** Sustainable contribution to food security, poverty alleviation and improved livelihoods of communities raising cattle.	M. Shamsuddin H. Unger
SIL/5/015	Enhancing Ebola Diagnostic Capacity using nuclear-derived technique at WHO/NICD EVD Lakka Laboratory, Freetown, Sierra Leone **Objective:** To support the national efforts and international response to combat Ebola outbreak in Sierra Leone.	I. Naletoski H. Unger G. Viljoen
SIL/5/018	Strengthening Artificial Insemination and Disease Diagnosis Services Coupled with Improved Feeding to Enhance the Productivity of Cattle **Objective**: To increase livestock productivity by improving artificial insemination (AI) services and the management of animal health and nutrition.	H. Unger M. Shamsuddin
SRL/5/042	Applying Molecular Diagnostics to Zoonotic Diseases **Objective**: To enhance the long term epidemic preparedness by developing competence in molecular diagnosis and surveillance of zoonotic infections.	H. Unger C. Lamien
SRL/5/045	Establishing a National Centre for Nuclear Agriculture **Objective**: To develop and implement programmes on the use of nuclear technology applications in the field of agricultural soil, water and plant nutrient studies, crop variety improvement and associated management technologies.	H. Unger C. Lamien
SRL/5/046	Improving Livelihoods Through Dairy Cattle Production: Women Farmers' Empowerment **Objective**: To increase the productivity of dairy farms and improve animal health and management practices.	M. Shamsuddin M. Garcia Podesta
SUD/5/036	Improving Livestock Production for Enhanced Food Security through Genetic Improvement of Indigenous Animal Breeds Using Artificial Insemination, Improved Nutrition and Adequate Animal Disease Control Measures **Objective**: To attain food security by improving livestock productivity.	N. Naletoski M. Garcia Podesta
THA/5/053	Enhancing Productivity and Control of Reproductive Diseases of Dairy Cattle and Buffaloes by Application of Nuclear-Based and Molecular Techniques **Objective**: To enhance productivity of dairy cattle and buffaloes in Thailand in order to obtain food security, poverty reduction and a good quality of life for farmers according to the national development programme for food and agriculture, with a focus on animal productivity and disease control.	G. Viljoen M Shamsuddin

TC Project	Description	Technical Officer(s)
TOG/5/001	Improving and Promoting Bovine Milk Production through Artificial Insemination **Objective:** To implement artificial insemination and improved feeding techniques to enhance the productivity of cattle farming as a tool to enhance food security in Togo.	M. Shamsuddin
TUN/5/028	Supporting Watering Strategies to Help Livestock Raised in Semiarid and Arid Regions Coping with Climate Change **Objective**: To characterize, analyse and to adjust watering strategies for livestock adopted in different production systems in the main agroecological areas of Tunisia. To enhance livestock performance, secure the sustainability of livestock-based production systems and contribute to the empowerment of livelihoods of rural communities.	M. Garcia Podesta I. Naletoski
UGA/5/035	Improving Food Safety through Surveillance of Fish Diseases **Objective**: To avail credible information about trace metals and aflatoxins in fish.	H. Unger C. Lamien
UGA/5/038	Supporting National Animal Production and Productivity through the Establishment of Regional Animal Health Centres and Improving Disease Control at the National Animal Disease Diagnostics and Epidemiology Centre **Objective:** To improve the national capacity for control of tranboundary animal and zoonotic diseases through well-coordinated and efficient diagnostic services at the National Animal Disease Diagnostics and Epidemiology Centre and the Regional Animal Disease Diagnostics and Epidemiology Centres in Uganda.	H. Unger
URT/5/027	Improving Livestock Production and Productivity through Sustainable Application of Nuclear and Related Techniques **Objective:** The broad objective of this project is to improve livestock production and productivity in the United Republic of Tanzania through sustainable application of various nuclear and nuclear related techniques.	M. Shamsuddin M. Garcia Podesta
URT/5/031	Improving Indigenous Cattle Breeds through Enhanced Artificial Insemination Service Delivery in Coastal Areas **Objective**: To improve the productivity of indigenous cattle through enhanced artificial insemination (AI) services delivery in coastal areas of Tanzania.	M. Shamsuddin
VIE/5/019	Applying Nuclear Related Techniques for Transboundary Animal Diseases (TADs) Diagnosis **Objective**: To contribute to the control and prevention of Transboundary Animal Diseases (TADs) in Viet Nam.	G. Viljoen V. Wijewardana
YEM/5/012	Improving Diagnostic and Analytical Capabilities of the Central Veterinary Laboratory Including Residue Testing of Animal Products **Objective**: To enhance livestock productivity and quality by reducing the incidence of livestock diseases.	H. Unger
ZAI/5/021	Upgrading Laboratory Services for the Diagnosis of Animal Diseases and Building Capacity in Vaccine Production to Support the Sustainability of Food Security and Poverty Alleviation **Objective:** To support the sustainability of food security and poverty alleviation through animal diseases diagnosis and immunization.	H. Unger

TC Project	Description	Technical Officer(s)
ZAI/5/023	Upgrading Laboratory Services for Capacity Building in Fish and Aquaculture Diseases as a Contribution to Sustainable Poverty Alleviation and Sanitary Security of Food **Objective**: To enhance advanced skills in the diagnosis and investigation of fish and aquaculture diseases as a contribution to sustainable poverty alleviation and sanitary security of food.	H. Unger
ZAI/5/024	Upgrading Vaccine Production to Protect Livestock from Transboundary Animal Disease **Objective:** To improve livestock productivity through the control of Trans-boundary Animal Diseases in the South of DRC.	H. Unger V. Wijewardana
ZAM/5/028	Improving Productivity of Dairy Animals Maintained on Smallholder Farms through Selected Breeding and Effective Disease Diagnosis and Control Using Isotopic and Nuclear Techniques **Objective:** To improve productivity of dairy animals maintained on smallholder farms in rural areas through selected breeding, effective disease diagnosis and control, improved supply of quality feeds and application of assisted animal reproduction technologies.	I. Naletoski M. Garcia
ZIM/5/022	Establishing Molecular Epidemiology Methods, Tissue Culture and Production of Biological Reagents for the Surveillance of Livestock Diseases **Objective:** To establish molecular epidemiology methods, tissue culture and production of biological reagents for the surveillance of livestock diseases in Zimbabwe.	I. Naletoski V. Wijewardana

Publications

Genetic variability and bottleneck analyses of Kanni adu goat population using microsatellite markers

M. Jeyakumar, R. Thiruvenkadan, R. Saravana, and ***K. Periasamy***

The Indian Journal of Small Ruminants, 2015, 21(2): 216–22

Microsatellite data on 25 loci were generated and utilized to evaluate the genetic architecture and mutation drift equilibrium of Kanni Adu goats of southern Tamil Nadu. The genetic diversity analysis of Kanni Adu goats displayed higher level of within breed variability in terms of mean number of alleles per locus (11.24±0.87) and heterozygosity values (Ho= 0.677±0.041, He=0.857±0.016). Within population inbreeding estimate (FIS=0.215±0.040) showed moderate level of inbreeding, which warrant adoption of appropriate breeding strategies under field conditions. The polymorphism information content (PIC) value ranged from 0.531 to 0.915 suggested higher polymorphism in this breed. In general, the sign, standardized differences and Wilcoxon rank tests indicated heterozygosity excess in Kanni Adu goat population in infinite alleles and two-phase model and non-significant in stepwise mutation model. Hence, the mode-shift indicator test was utilized and it indicated the absence of genetic bottleneck in the recent past in Kanni Adu goats. It suggests that any unique alleles present in this breed may not have been lost. The study indicated that Kanni adu goats exhibited substantial amount of genetic variation as reflected from the heterozygosity and number of alleles per locus.

Peste des petits ruminants in Benin: Persistence of a single virus genotype in the country for over 42 years

C.M. Adombi, *A. Waqas,* ***W.G. Dundon,*** *S. Li, Y. Daojin, L. Kakpo, G.L. Aplogan, M. Diop, M.M. Lo, R. Silber, A. Loitsch,* ***A. Diallo***

Transbound Emerg Dis. 2016. doi: 10.1111/tbed.12471

Peste des petits ruminants (PPR) is a contagious and often fatal disease affecting sheep and goats. Currently, it is

endemic in Africa, the Middle and Near East, the Indian subcontinent and China. Understanding the molecular epidemiology and evolution of PPR virus (PPRV) can assist in the control of the transboundary spread of this economically important disease. We isolated PPRV from pathological and swab samples collected 42 years apart (1969 and 2011) in Benin, West Africa, and sequenced the full genome of two isolates (Benin/B1/1969 and Benin/10/2011). Phylogenetic analysis showed that all of the characterized isolates clustered within viral lineage II and that the 2011 isolates fell into two distinct subgroups. Comparison of the full genome sequences revealed a 95.3% identity at the nucleotide level, while at the protein level, the matrix protein was the most conserved between the two viruses with an identity of 99.7% and only one amino acid substitution over the 42-year sampling period. An analysis of specific amino acid residues of known or putative function did not identify any significant changes between the two viruses. A molecular clock analysis of complete PPRV genomes revealed that the lineage II viruses sampled here arose in the early 1960s and that these viruses have likely persisted in Benin since this time.

One-Step Multiplex RT-qPCR Assay for the detection of Peste des petits ruminants virus, Capripoxvirus, Pasteurella multocida and Mycoplasma capricolum subspecies (ssp.) capripneumoniae

T.B.K. Settypalli , ***C. Lamien,*** *J. Spergser,* ***M. Lelenta,*** *A. Wade, E. Gelaye, A. Loitsch, G. Minoungou, F. Thiaucourt,* ***A. Diallo***

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Respiratory infections, although showing common clinical symptoms like pneumonia, are caused by bacterial, viral or parasitic agents. These are often reported in sheep and goats populations and cause huge economic losses to the animal owners in developing countries. Detection of these diseases is routinely done using ELISA or microbiological methods which are being reinforced or replaced by molecular based detection methods including multiplex assays, where detection of different pathogens is carried out in a single reaction. In the present study, a one-step multiplex RT-qPCR assay was developed for simultaneous detection of Capripoxvirus (CaPV), Peste de petits ruminants virus (PPRV), Pasteurella multocida (PM) and Mycoplasma capricolum ssp. capripneumonia (Mccp) in pathological samples collected from small ruminants with respiratory disease symptoms. The test performed efficiently without any cross-amplification. The multiplex PCR efficiency was 98.31%, 95.48%, 102.77% and 91.46% whereas the singleplex efficiency was 93.43%, 98.82%, 102.55% and 92.0% for CaPV, PPRV, PM and Mccp, respectively. The correlation coefficient was greater than 0.99 for all the targets in both multiplex and singleplex. Based on cycle threshold values, intra and inter assay variability, ranged between the limits of 2%–4%, except for lower concentrations of Mccp. The detection limits at 95% confidence interval (CI) were 12, 163, 13 and 23 copies/reaction for CaPV, PPRV, PM and Mccp, respectively. The multiplex assay was able to detect CaPVs from all genotypes, PPRV from the four lineages, PM and Mccp without amplifying the other subspecies of mycoplasmas. The discriminating power of the assay was proven by accurate detection of the targeted pathogen (s) by screening 58 viral and bacterial isolates representing all four targeted pathogens. Furthermore, by screening 81 pathological samples collected from small ruminants showing respiratory disease symptoms, CaPV was detected in 17 samples, PPRV in 45, and PM in six samples. In addition, three samples showed a co-infection of PPRV and PM. Overall, the one-step multiplex RT-qPCR assay developed will be a valuable tool for rapid detection of individual and co-infections of the targeted pathogens with high specificity and sensitivity.

Multilocus genotypic data reveal high genetic diversity and low population genetic structure of Iranian indigenous sheep

S.M.F. Vahidi, M.O. Faruque, M. Falahati Anbaran, F. Afraz, S.M. Mousavi, P. Boettcher, S. Joost, J.L. Han, L. Colli, ***K. Periasamy****, R. Negrini, P. Ajmone-Marsan*

Animal Genetics. 2016. doi: 10.1111/age.12429

Iranian livestock diversity is still largely unexplored, in spite of the interest in the populations historically reared in this country located near the Fertile Crescent, a major livestock domestication centre. In this investigation, the genetic diversity and differentiation of 10 Iranian indigenous fat-tailed sheep breeds were investigated using 18 microsatellite markers. Iranian breeds were found to host a high level of diversity. This conclusion is substantiated by the large number of alleles observed across loci (average 13.83, range 7–22) and by the high within-breed expected heterozygosity (average 0.75, range 0.72–0.76). Iranian sheep have a low level of genetic differentiation, as indicated by the analysis of molecular variance, which allocated a very small proportion (1.67%) of total variation to the between-population component, and by the small fixation index (FST = 0.02). Both Bayesian clustering and principal coordinates analysis revealed the absence of a detectable genetic structure. Also, no isolation by distance was observed through comparison of genetic and geographical distances. In spite of high within-breed variation, signatures of inbreeding were detected by the FIS indices, which were positive in all and statistically significant in three breeds. Possible factors

explaining the patterns observed, such as considerable gene flow and inbreeding probably due to anthropogenic activities in the light of population management and conservation programmes are discussed.

Identification of a new genotype of African swine fever Virus in domestic pigs from Ethiopia

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Transbound Emerg Dis. 2016. DOI: 10.1111/tbed.12511

African swine fever (ASF) is an important emerging transboundary animal disease (TAD), which currently has an impact on many countries in Africa, Eastern Europe, the Caucasus and the Russian Federation. The current situation in Europe shows the ability of the virus to rapidly spread, which stands to threaten the global swine industry. At present, there is no viable vaccine to minimize spread of the disease and stamping out is the main source of control. In February 2011, Ethiopia had reported its first suspected outbreaks of ASF. Genomic analyses of the collected ASF virus (ASFV) strains were undertaken using 23 tissue samples collected from domestic swine in Ethiopia from 2011 to 2014. The analysis of Ethiopian ASFVs partial p72 gene sequence showed the identification of a new genotype, genotype XXIII that shares a common ancestor with genotypes IX and X, which comprise isolates circulating in Eastern African countries and the Republic of Congo. Analysis of the p54 gene also followed the p72 pattern and the deduced amino acid sequence of the central variable region (CVR) of the B602L gene showed novel tetramer repeats not previously characterized.

Development of broad-spectrum human monoclonal antibodies for rabies post-exposure prophylaxis

P. de Benedictis, A. Minola, E. Rota, R. Aiello, B. Zecchin, A. Salomoni, M. Foglierini, G. Agatic, F. Vanzetta, R. Lavenir, A. Lepelletier, E. Bentley, R. Weiss, ***G. Cattoli***

EMBO Molecular Medicine. 2016. 8: 407–421. doiI 10.15252/emmm.201505986

Currently available rabies post-exposure prophylaxis (PEP) for use in humans includes equine or human rabies immunoglobulins (RIG). The replacement of RIG with an equally or more potent and safer product is strongly encouraged due to the high costs and limited availability of existing RIG. In this study, we identified two broadly neutralizing human monoclonal antibodies that represent a valid and affordable alternative to RIG in rabies PEP. Memory B cells from four selected vaccinated donors were immortalized and monoclonal antibodies were tested for neutralizing activity and epitope specificity. Two antibodies, identified as RVC20 and RVC58 (binding to antigenic site I and III, respectively), were selected for their potency and broad-spectrum reactivity. In vitro, RVC20 and RVC58 were able to neutralize all 35 rabies virus (RABV) and 25 non-RABV lyssaviruses. They showed higher potency and breath compared to antibodies under clinical development (namely CR57, CR4098, and RAB1) and commercially available human RIG. In vivo, the RVC20–RVC58 cocktail protected Syrian hamsters from a lethal RABV challenge and did not affect the endogenous hamster post-vaccination antibody response.

Phylogenetic analysis of Newcastle disease viruses isolated from commercial poultry in Mozambique, 2011 to 2016

L.P. Mapaco, I.V.A. Monjane, A.E. Nhamusso, ***G.J Viljoen***, ***W.G. Dundon***, *S.J. Achá*

Virus Genes DOI: 10.1007/s11262-016-1362-6

The complete sequence of the fusion (F) protein gene from eleven Newcastle disease viruses (NDV) isolated from commercial poultry in Mozambique between 2011 and 2016 has been generated. The F gene cleavage site motif for all eleven isolates was 112RRRKRF117 indicating that the viruses are virulent. A phylogenetic analysis using the full F gene sequence revealed that the viruses clustered within genotype VIIh and showed a higher similarity to NDVs from South Africa, China and Southeast Asia than to viruses previously described in Mozambique in 1994 to 1995 and 2005. The characterization of these new NDVs has important implications for Newcastle disease management and control in Mozambique.

Molecular characterization of orf virus from sheep and goats in Ethiopia, 2008–2013

E. Gelaye, J.E. Achenbach, *S. Jenberie, G. Ayelet, A. Belay, M. Yami, A. Loitsch, R. Grabherr,* ***A. Diallo***, ***C.E. Lamien***

Virol J. 2016 Feb 29;13:34. doi: 10.1186/s12985-016-0489-3

Orf is a contagious disease of sheep, goats and wild ungulates caused by orf virus (ORFV) a member of the genus Parapoxvirus, Poxviridae family. Although orf is endemic in Ethiopia, little attention has been given so far as it is not a notifiable disease by the World Organization for Animal Health. In this work, we have investigated orf

outbreaks representing five different geographical locations of Ethiopia, in Amba Giorgis, Gondar Zuria, Adet, Debre Zeit and Adami Tulu, between 2008 and 2013.

The viral isolation and the sequence analysis of the A32L and the B2L genes of eighteen representative isolates confirmed that sampled animals were infected by ORFVs. The phylogenetic study and the comparative analysis of the deduced amino acid profile suggests that there were two main clusters of ORFV isolates which were responsible for the investigated outbreaks. Additionally the analysis of these two genes showed limited variability to ORFVs encountered elsewhere. This is the first report on the genetic characterization of the ORFV isolates from sheep and goats in Ethiopia.

The molecular characterization of Ethiopian ORFV isolates highlighted the circulation of two main clusters causing orf disease in sheep and goats. The use of laboratory based methods and a constant monitoring of Ethiopian ORFV isolates is needed to better understand the dynamic of ORFV circulating in the country and facilitate the implementation of control measures.

VETLAB Network

The APH supported veterinary diagnostic laboratories in Member States towards the successful worldwide eradication of rinderpest through the FAO/IAEA Rinderpest Laboratory Network. Building on this success, APH continues its efforts in maintaining and building diagnostic laboratory capacities to support the control of animal and zoonotic disease threats to MS in cooperation with the FAO and OIE. The VETLAB Network participants are being supported through IAEA and FAO programmatic activities as well as by South Africa through the African Renaissance Fund (ARF) and USA and Japan Peaceful Uses Initiative (PUI). Currently there are 40 African and 17 Asia and Pacific VETLAB partners.

APH is now taking an additional step in introducing the VETLAB Network Bulletin in the hope of providing a forum for participating laboratories and other stakeholders to communicate and exchange knowledge/information, to showcase achievements and to share expertise within the VETLAB Network.

Impressum

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