Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Animal Production & Health Newsletter

http://www-naweb.iaea.org/nafa/index.html
http://www.fao.org/ag/portal/index_en.html

ISSN 1011-2529

No. 65, January 2017

Contents

To Our Readers

Camel rearing is an important means of rural livelihood in arid Mauritania.

Dear Colleagues,

It is with gratitude that I thank you all for your cooperation, loyalty and support to the Animal Production and Health Section of the Joint FAO/IAEA Division during 2016. This was indeed a momentous year, with constant emerging and re-emerging food security challenges throughout the world. In particular, we need to take note of the lumpy skin disease and African swine fever outbreaks in Eastern Europe and the Balkans, the highly pathogenic avian influenza H5N1/H5N8/H5N6/H7N9 outbreaks in Asia and Africa and the peste-des-petite-ruminants outbreaks in Asia. I want to thank all for their effective support (staff and counterparts) in making our actions count. I hope that our interactions will continue to grow as each year passes by and with each newsletter.

As 2016 draws to an end, we are in the process of preparing our IAEA and FAO Programmes of Work and Budget for 2018–2019 and I would like to use this opportunity to reconfirm our commitment to support and to enhance animal production and health activities in our Member States. We plan to continue on our programmatic shift towards value-added atomic, nuclear and nuclear

related/derived immunological and molecular based technologies to:

- optimally utilize available and alternative animal feed resources to support maximum energy conversion whilst limiting loss (i.e. promoting climate smart agriculture). This will include the tracing and monitoring of their energy conversion *in vivo*,
- improve the production traits of locally available livestock breeds towards more and better quality milk and meat through reproduction and genetic adaptation,
- develop and transfer early and rapid diagnostic technologies for transboundary animal and zoonotic diseases, including those with bio-threat nature, to enable Member States to respond to the risks posed by such events earlier and with greater effectiveness,
- the use of gamma-radiated diagnostic reagents and components and inactivated/killed disease pathogens as vaccine components, and the use of stable isotopes to trace and monitor pathways of disease carriers in a non-invasive way.

Livestock production systems in developing countries are becoming progressively more intensified responding to demands from consumers for milk, meat and other livestock products. This will require government authorities and their institutions to address the challenges likely to arise from intensification and increased productivity without degrading feed and genetic resources, while ensuring that diseases of a transboundary, zoonotic or bio-threat nature that affect trade, animal and human health are brought under control and/or eradicated while protecting the environment and mitigating climatic variations. Increasing demand can only be met through the selection of trait favourable animals that give more and better quality meat and milk, show resistance to diseases or climatic conditions, whilst ensuring optimal utilization of locally available animal breeding and genetic resources, and in protecting animals from diseases.

It is hoped that our programme will assist Member States in the development and application of atomic, nuclear and nuclear related/derived technologies, used independently or in combination with standard and/or advanced biomolecular techniques, for: (i) early and rapid diagnoses and control of transboundary animal and zoonotic diseases, including those of a bio-threat nature; (ii) optimal use of locally available natural resources (water, land, plant/feed); (iii) optimal reproduction and breeding/biodiversity strategies (including the characterization of genetic biodiversity), and; (iv) adapting to and mitigating the effects of climate change on animal production and health and the effect of livestock on climatic conditions. These activities involve substantial and continuous development, validation and transfer of appropriate technologies.

On the staff front, the Section welcomed Ms Juliette Elsan and Anna Gaggl. Ms Elsan is conducting her Master Degree program at the University of Montpellier (France) on emerging infectious and parasitic diseases. She joined the APH team in September 2016 for an internship of six months on rapid detection of animal infectious diseases and pathogen characterization. Ms Gaggl is a Bachelor student of Biology at the University of Vienna. She joined the APH team in July 2016 for an internship of seven months on animal genetics, focusing on the radiation hybrid mapping of the camel genome. I hope both of them are having a fruitful and pleasant experience in our team. Also, the Section had to say goodbye to Jenna Achenbach and Polina Perelman. Ms Achenbach moved back to the United States where she will continue her scientific career. During the past three years Ms Achenbach has worked at APH on the molecular epidemiology of important transboundary animal diseases, such as African swine fever and avian influenza. Ms Perelman returned to the Institute of Cellular and Molecular Biology, Novosibirsk, Russia after her successful consultancy of six months at APHL. Ms Perelman was actively involved in establishing the facility for construction of radiation hybrid panels at Seibersdorf laboratories. Her work on camel genome has greatly contributed to the development of much required mapping resources and development of genetic tools for improvement of camel productivity. On behalf of the whole APH team, I would like to express my gratitude to Ms Achenbach and Ms Perelman and wish success with the continuation of their careers.

Our past, present and future activities are described in further detail on our website and I strongly encourage you all to visit it and to let us know of your ideas, comments, concerns or questions. Please also note the feature on the '60th Anniversary of the International Atomic Energy Agency' in this newsletter.

Finally, I wish you and your families all the best in the year ahead.

Gerrit Viljoen,
Head, Animal Production and Health Section

IAEA 60 Years
Atoms for Peace and Development

Set up in 1957 as the world's centre for cooperation in the nuclear field, the International Atomic Energy Agency (IAEA) works with its Member States and multiple partners worldwide, especially in the developing world, to promote the safe, secure and peaceful use of nuclear technologies. In September 2016, the IAEA held its sixtieth regular session of the General Conference, and in recognition thereof, the Secretariat will commemorate its sixtieth anniversary throughout the coming year.

Nuclear technologies continue to provide competitive and often unique solutions to help fight hunger and malnutrition, combat plant and animal diseases and pests, improve agricultural productivity and environmental sustainability and ensure that food is safe. Since 1964, the IAEA and the Food and Agriculture Organization of the United Nations (FAO) have worked in partnership through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture to help Member States use these technologies safely and appropriately. Throughout this time the programme of the Joint FAO/IAEA Division, with its unique laboratories at Seibersdorf, has continuously evolved to meet the world's changing needs. In doing so, it has focused on expanding its ongoing contribution to agricultural development and global food security, and proactively embraced and added its expertise to efforts to adapt to and mitigate the effects of climate change, respond to globalization, conserve ecosystem services and broaden biodiversity. Today, it strives to mobilize commitment and concerted action towards meeting the Sustainable Development Goals of the United Nations through the appropriate integration of nuclear and related technologies for sustainable agriculture development and food security.

We take this opportunity to thank our numerous partners worldwide, whether institutions or individuals, for their dedication and continuous support to our mission since 1964.

In this issue:

To the readers

For the first time, the technical meeting of the VETLAB network with the directors of veterinary laboratories was jointly organized for Africa and Asia. The laboratory network and the meeting are supported by the African Renaissance Fund and the Peaceful Uses Initiative to Strengthen Animal Disease Diagnostic Capacities. The event took place at the IAEA's Headquarters in Vienna, Austria, from 16 to 18 August 2016. Nineteen laboratories from 18 countries participated to the meeting to provide update on their progress, achievements and challenges in 2015.

The meeting was held in parallel with the RCM of the VETLAB CRP D3.20.32 (Early Detection of Transboundary Animal Diseases to Facilitate Prevention and Control through a Veterinary Diagnostic Laboratory Network) to allow the interaction between the laboratory directors and the CRP experts. The VETLAB partners highlighted the important contributions of the CRP and the IAEA support. Moreover, the partners' laboratories have stressed the importance of the project in bringing several veterinary laboratories from Asia and Africa together to share their experience and knowledge. All together, we strongly believe that initiatives like this, bringing together people, expertise and ideas can successfully promote progress and skills, providing a unique platform for technical and scientific development in Member States. This is definitely the most important goal for a successful technical network.

We look forward to meet all of you next year!

We wish you a happy and prosperous 2017.

VETLAB Highlights

Re-emergence of avian influenza H5N1 in Africa

Since the 1/2016 issue of the VETLAB Network Bulletin, the avian influenza HPAI-H5N1 virus has made the list of West Africa affected countries longer. In June 2016 Cameroon officially reported to the OIE the presence of this virus. Since then, 18 outbreaks have been notified. LANAVET ensured the first detection and laboratory confirmation of this virus within a few hours.

Trans-continental spread of avian influenza H5N8

The highly pathogenic avian influenza HPAI-H5N8 has spread westward from Asia in the last six months. The latest countries reporting the virus – in wild birds or in poultry – are Russia, India, Iran, Israel and several countries in Central Europe (October/November 2016). To date, human infections caused by this virus have not been reported.

Peste des Petit Ruminants virus (PPRV) outbreak in Mongolia

In August 2016, the State Central Veterinary Laboratory (SCVL) in Ulaanbaatar, Mongolia detected PPRV infections in samples collected in the west part of Mongolia. This is the first report on PPRV in this country. The implementation in SCVL of multi-pathogen detection assays developed and validated with the assistance of APHL and the support of PUI Japan made the rapid detection and confirmation possible.

New insights into capripox virus infections in Ethiopia

We are pleased to inform you that on 14th October 2016, Dr Esayas Gelaye from the National Vaccine Institute in Debre Zeit (Ethiopia) successfully defended his PhD thesis at the Boku University in Vienna. Dr Gelaye focused on the genetic characterization of poxviruses of ruminants and camels in Ethiopia and on the development of differential diagnostic and disease surveillance tools. The study was conducted in collaboration with the Joint FAO/IAEA Division APHL and the support of the PUI-USA.

1/2017

VETLAB Network Bulletin

VETLAB Capacity Building Initiatives

Support missions

Twenty two VETLAB partner laboratories in 13 countries were visited by APHL staff and IAEA experts in 2016. 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.

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

Twenty participants from 19 countries in Africa and Asia were invited to participate in the training course held from 05-16th December 2016 at Seibersdorf Laboratories, Austria. The purpose of this training was "to promote the application of advanced rapid and differential diagnoses of multiple pathogens" in the targeted veterinary laboratories and strengthen the capacity to detect, conduct surveillance, and perform epidemiological studies on the major pathogens associated with respiratory diseases in small ruminants.

VETLAB Networking Activities

- **The VETLAB Network laboratories**

The National Animal Health Laboratory – NAHL -in Laos (Department of Livestock and Fisheries/Ministry of Agriculture and Forestry)

The National Animal Health Laboratory in Vientiane, Laos. NAHL staff involved in trainings supported by the Joint FAO/IAEA Division

1. The laboratory mandate: Disease diagnoses and surveillance; quality testing (i.e. detecting veterinary drug residues in meat, eggs and milk), capacity building.
2. The laboratory activities: Diagnostic testing for transboundary testing are also routinely carried out. In the previous fiscal year, the NAHL processed and tested approximately 15,000 samples.
3. The laboratory over the last 5 years: In 2012 the NAHL requested the OIE PVS Laboratory Gap Analysis and identified three key areas for improvement [e.g. the need for a Laboratory Information Management (LIMS), improved biosafety and quality assurance]. Following a reassessment by OIE PVS in 2013 and 2015, a significant improvement in these areas has been noticed.
4. Important to note: Over the last few years NAHL has improved its capacity and capability in performing diagnostic tests for several bacterial, viral and parasitic disease of animals Importantly, the NAHL recently scored 100% in both molecular and serological detection of Peste des Petites Ruminants virus in the VETLAB supported sponsored proficiency test for PPRV
5. Future laboratory objectives: Over the next three years NAHL will continue to focus on the three key areas identified in 2012. Regional and international harmonization of test protocols and procedures is also considered an important goal along with continued human resource development through capacity building activities. Access to bioinformatic support that will assist emerging infectious disease control programmes is considered a priority. Finally, the NAHL plans to be certified and accredited under ISO 17025 for at least three diagnostic tests by 2019.

- **Interlaboratory test for the diagnosis of PPR**

The 2016 Interlaboratory Proficiency Test (PT) for the Diagnosis of Peste des Petits Ruminants (PPR) organized by the Animal Production and Health Laboratory has been conducted. This year, the PPR PT consisted of two panels of 11 and 10 samples for serological and molecular testing, respectively. Twenty-seven laboratories, representing 24 countries in three continents, participated in the exercise. Nearly 80% of the laboratories showed 100% accurate results when using serology and real-time RT-PCR. We thank all of the participating laboratories and expect a higher number of participating laboratories next year.

- **VETLAB Research Coordination Meeting (RCM)**

The first RCM on the VETLAB Coordinated Research Project was held from 15-19 August 2016 in Vienna. The project partners from Argentina, United Kingdom, Cameroon, Croatia, Ethiopia, Ivory Coast, Morocco, Sudan and the FYR of Macedonia have discussed the technical details on the production of serological and molecular standards for priority animal and/or zoonotic diseases of animals, the development of ISO17025 compatible SOPs and instructions for laboratory testing, the use of multi-pathogen detection platforms for simultaneous detection and differentiation of priority diseases of animals.

Impressum: VetLab Network Bulletin No. 03 • Edited and designed by the Animal Production and Health Section, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture • International Atomic Energy Agency • Vienna International Centre, PO Box 100, 1400 Vienna, Austria • Printed by the IAEA in Austria, Mai 2015

Staff

Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture

Name	Title	Email	Extension	Location
Qu LIANG	Director, NAFA	Q.Liang@iaea.org	21610	Vienna

Animal Production and Health Subprogramme

Name	Title	Email	Extension	Location
Gerrit J. VILJOEN	Section Head	G.J.Viljoen@iaea.org	26053	Vienna
Ivancho NALETOSKI	Veterinarian, Serologist	I.Naletoski@iaea.org	26054	Vienna
Mohammed SHAMSUDDIN	Veterinarian, Livestock Reproductionist/Breeder	M.Shamsuddin@iaea.org	21619	Vienna
Hermann UNGER	Veterinarian, Virologist	H.Unger@iaea.org	21644	Vienna
Mario GARCIA PODESTA	Veterinarian, Theriogenologist	M.Garcia-Podesta@iaea.org	26048	Vienna
Svetlana PIEDRA CORDERO	Team Assistant	S.Piedra-Cordero@iaea.org	26051	Vienna
Roswitha REITER	Programme Assistant	R.Reiter@iaea.org	26052	Vienna
Giovanni CATTOLI	Laboratory Head	G.Cattoli@iaea.org	28355	Seibersdorf
Charles E. LAMIEN	Biochemist	C.Lamien@iaea.org	28314	Seibersdorf
Kathiravan PERIASAMY	Livestock Geneticist Breeder	K.Periasamy@iaea.org	28358	Seibersdorf
Viskam WIJEWARDANA	Immunologist	V.Wijewardana@iaea.org	28380	Seibersdorf
Joanna MLETZKO	Team Assistant	J.Mletzko@iaea.org	28362	Seibersdorf
Rudolf PICHLER	Livestock Geneticist	R.Pichler@iaea.org	28378	Seibersdorf
Francisco BERGUIDO	Immunologist	F.Berguido@iaea.org	28356	Seibersdorf
William DUNDON	Molecular Microbiologist	W.Dundon@iaea.org	28379	Seibersdorf
Richard KANGETHE	Molecular Parasitologist	R.T.Kangethe@iaea.org	28385	Seibersdorf
Bharani SETTYPALLI	Molecular Biologist	T.B.K.Settypalli@iaea.org	28252	Seibersdorf
Juliette ELSAN	Intern	J.Elsan@iaea.org	28321	Seibersdorf
Anna GAGGL	Intern	T.Gaggl@iaea.org	28321	Seibersdorf

Animal Production and Health Section
Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture
Vienna International Centre, P.O. Box 100, A-1400 Vienna, Austria
Telephone: (+43 1) 2600+Extension; Fax (+43 1) 26007

Animal Production and Health Laboratory
FAO/IAEA Agriculture & Biotechnology Laboratories, A-2444 Seibersdorf, Austria
Telephone: (+43 1) 2600+Extension; Fax (+43 1) 26007

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

Animal Production and Health Subprogramme


G. VILJOEN


I. NALETOSKI


M. SHAMSUDDIN


H. UNGER


M. GARCIA


S. PIEDRA-CORDERO


R. REITER


J. MLETZKO


G. CATTOLI


C. LAMIEN


K. PERIASAMY


V. WIJEWARDANA


R. PICHLER


F. BERGUIDO


W. DUNDON


R. KANGETHE


J. ELSAN


A. GAGGL


B. SETTYPALLI

Forthcoming Events

First Research Coordination Meeting on the Quantification of Intake and Diet Selection of Ruminants Grazing Heterogeneous Pasture Using Compound Specific Stable Isotopes

Technical Officers: Mohammed Shamduddin, Mario Garcia Podesta

The research coordination meeting will take place from 23 to 27 January 2017 in Vienna, Austria. The objectives of the meeting are to review and finalize workplans of individual research contracts, identify research and development tools and methods to be adopted in the CRP, formulate guidelines to follow and advice on way forward, connectivity, research and development needs to improve pastoral animal production while protecting the environment.

First Research Coordination Meeting on the Irradiation of Transboundary Animal Disease Pathogens as Vaccines and Immunity Inducers

Technical Officer: Hermann Unger, Viskam Wijewardana

The research coordination meeting will take place from 3 to 7 April 2017 in Vienna, Austria.

After the first coordinated research project (CRP) on irradiated vaccines, the basic processes of how to produce experimental batches of irradiated vaccines are understood and implemented. This first coordination meeting will explore the way forward to increase the volume of irradiated vaccines, their preservation and quality control and immunology issues involved. The participants of the new CRP and experts will be invited to present their projects, design together the experimental approaches, define the work plans and the animal trials. Vaccination immunology of the different species and application of different technologies will be covered as well as standardization of the technical approaches for defining protection in absence of challenge trials. Preservation technologies will be discussed at a separate session of this meeting.

Mid-Term Coordination Meeting - RAF/5/068: Improving Livestock Productivity through Strengthened Transboundary Animal Disease Control using Nuclear Technologies to Promote Food Security (AFRA)

Technical Officers: Hermann Unger, Charles Lamien

The mid-term coordination meeting will take place from 23 to 27 January 2017 in Lusaka, Zambia.

The project RAF5068 was initiated to integrate livestock disease control in support of increased livestock productivity to enhance food security in order 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.

The purpose of the meeting is to review the progress made and results achieved in each participating country, highlighting bottlenecks and lessons learned from the implementation of the project activities; define actions to be taken in each participating country and prepare a detailed work plan for the next cycle.

The meeting is open for participation from AFRA Member States participating in the RAF5068.

Regional training on Health Management of Small Ruminants Targeting Parasites Control (RLA5071)

Technical Officer: Mohammed Shamsuddin

The one-week regional training course aims at providing further skills on the management of major diseases of sheep and goats including gastrointestinal parasites to animal health professionals. The training will be held during the second quarter of 2017. The course will be limited to participants from the Latin American and the Caribbean countries. The course prospectus and venue are yet to be finalized.

Past 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 first RCM of the CRP D32032 was held from 15 to 19 August 2016 at the IAEA Headquarters in Vienna, Austria.

The participants at the meeting were the contract holders: Dr Ana Maria Nicola (OIE reference laboratory for brucellosis, SENASA, Argentina), Dr Florence Cliquet (EU reference laboratory for rabies, ANSES, France), Dr John Flannery (Non-vesicular reference laboratory, Pirbright Institute, UK), Dr Robert Nenkam (LANAVET laboratory, Yaoundé, Cameroon), Dr Vladimir Savic (Croatian Veterinary Institute, Zagreb, Croatia), Dr Yao Koffi (LANADA Laboratory, Bingerville, Ivory Coast), Dr Kiril Krstevski (Faculty of veterinary medicine, Skopje, The FYR of Macedonia), Dr Sami Darkaoui (ONSSA laboratory, Rabat, Morocco), Dr Ibtisam Goreish (Central Veterinary Laboratory, Khartoum, Sudan) and Dr Tesfaye Rufael (NAHDIC laboratory, Sebeta, Ethiopia).

The partners of the project have agreed to produce molecular and serological standards for the priority animal and zoonotic diseases like brucellosis, rabies, African swine fever (ASF), avian influenza (AI), peste des petits ruminants (PPR), lumpy skin disease (LSD), sheep pox and goat pox. The standards produced will be verified according to the criteria defined in the OIE manual of diagnostic methods and the ISO Guide 35 for production of reference materials, under supervision of the technical partners in the project. For each of the mentioned diseases, recognized and verified standard operating procedures will be adopted and written in an ISO 17025 template and shared with all counterparts of the APH Subprogramme via the VETLAB Information Platform.

Once the panel of standards is developed the project partners will organize a standardized trial on the use of gamma rays to inactivate biological materials without affecting their serological or molecular properties (titer in the serological or Ct value in the real time PCR assays).

During the development of the standards, the partners will use the multi-pathogen detection assays developed by APHL, Seibersdorf, Austria, will verify/improve the sequencing services of APH and will use the VETLAB Information Platform for information upload and exchange.

Contract holders of the CRP D32032 during the first RCM at the IAEA Headquarters in Vienna, Austria.

Regional Training Courses number 1&2 on the Nuclear and Nuclear Related Techniques for Early and Rapid Detection and Confirmation of Pox Virus Infections in Animals (RER9137)

Technical Officers: Ivancho Naletoski, Charles Lamien

The training courses took place from 15 to 19 and 22 to 26 August in Vienna, Austria.

During the spring of 2016, the numerous outbreaks of lumpy skin disease (LSD) appeared in the countries of the southern Europe, initially in Greece, however rapidly entering Bulgaria, the FYR of Macedonia, Serbia and Montenegro. As LSD was considered an exotic disease for Europe, the laboratories of most Member States of the region did not have appropriate diagnostic tools to early detect the causative pathogen.

As a matter of emergency, the APHS has organized two training courses supported by Technical Cooperation aimed at dissemination of the necessary cutting-edge molecular techniques for detection and differentiation of the capripoxviruses. The courses were held 15–19 August and 22–26 August 2016. Thirty seven participants from 23 Member States of the IAEA European region have attended the courses. The courses included practical, on-the-spot classes in a validated, pan-capripox, real-time PCR protocol [Bowden TR, et al. (2008); Virology 371; 380–393; Stubbs S et al. (2012); J.Virol.Methods 179; 419– 422], two conventional PCR protocols for differentiation of the LSD viruses from sheep-pox and goat-pox [Lamien CE et al. (2011); Veterinary Microbiology 149; 30–39 and Esayas G. (2015); Antiviral Research 119; 28–35], as well as a real time PCR protocol used for simultaneous detection, quantitation and differentiation of capripoxviruses [Lamien CE, et al. (2011); J.of Virol.Meth; 171/1; 134–140].

The courses also included practical classes in bio-informatics, used for analysis of genetic viral sequences, genetic clustering and sharing at the publicly available online genetic databases, such as the NCBI-Genbank.

APH has established a free-of-charge genetic sequencing service for all officially designated laboratories in Member States, as well as a delivery of an emergency diagnostic toolkits for all participating laboratories comprised of the necessary reagents for approximately 500 runs with appropriate SOPs for immediate implementation in the local laboratories.

Participants at the training courses on diagnosis of LSD in front of the APH laboratory in Seibersdorf, Austria.

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 took place from 16 to 18 August 2016 in Vienna, Austria.

A joint technical meeting of the VETLAB network was organized with the directors of veterinary laboratories in Africa and Asia that are supported by the African Renaissance Fund and the Peaceful Uses Initiative to Strengthen Animal Disease Diagnostic Capacities. This was the third technical meeting for the African veterinary directors and the second for the Asian laboratory directors. Nineteen laboratories from 18 countries participated at the meeting to provide update on their progress, achievements and challenges met in 2015.

The meeting was held in parallel with first RCM of the VETLAB CRP D32032 (Early Detection of Transboundary Animal Diseases to Facilitate Prevention and Control through a Veterinary Diagnostic Laboratory Network) to allow the interaction between the laboratory directors and the CRP experts and their critical assessment of the CRP work plan.

The VETLAB partners have highlighted the important contributions of the project and IAEA support in general in achieving these successes. Moreover, the partners' laboratories have stressed the importance of the project in bringing several veterinary laboratories from Asia and Africa together to share their experience and knowledge. They also acknowledged the interesting interaction with the experts supporting the VETLAB CRP and have supported the proposed objectives and work plan of the VETLAB CRP.

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 took place from 26 to 30 September 2016 in Yaoundé, Cameroon.

The National Veterinary Laboratory (LANAVET), Yaoundé - Cameroon hosted the RAF5073/003 Regional training course on Enhancing Capacity of National Monitoring Teams for Diagnosis of Ebola virus disease (EVD) under High Bio-Safety Conditions. This event was supervised by Dr Abel Wade, course Director and Director of LANAVET. Three lecturers and twenty English speaking participants from 11 African countries (Algeria, Eritrea, Zimbabwe, Madagascar, Ghana, Niger, Côte d'Ivoire, Kenya, Burundi, Senegal and Cameroon) from ONE HEALTH concept (animal health, human health, wildlife and environmental sectors) were present.

Group picture of participants with the lecturers and Cameroon Minister in charge of livestock following handing over of certificates.

The main purpose of the training course was 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). Knowledge and know-how transfer have resulted on the following outputs: i) Increased awareness about the potential risks related to collection, handling and transport of samples, potentially containing viruses causing EZD and EVD, ii) Increased knowledge on the use of personal protective equipment during collection, handling and transport of samples, potentially containing viruses causing EZD and EVD, iii) Improved biosecurity and organizational settings in Member States for collection, handling and transport of samples, potentially containing viruses causing EZD and EVD, and iv) Improved capacity to response to bio-hazardous emergencies during collection, handling and transport of samples, potentially containing viruses causing EZD and EVD. Topics fully taught and discussed were similar to the RAF0042/003 mentioned separately with the difference that this was conducted in English language. All the participants were fully satisfied with the training and votes of thanks were addressed to IAEA for all the support. Although the course was 75% practicals oriented, participants requested for more time (two weeks training) in order to also cover practical for various animal species due to the multiple emerging unspecific-host pathogens causing hemorrhagic fevers. We suggested that the topics to be included in future courses may take into account the capturing of live bats for sampling, the use of Global Positioning System (GPS) to geo-monitor transboundary emerging zoonotic pathogen host carriers including EVD. Present Member States have expressed the wish to have these trainings in each of the countries not only in order to initiate this ONE HEALTH concept, but to also train more trainers in the local field conditions.

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 took place from 22 to 26 August 2016 in Asuncion, Paraguay.

The objectives of the meeting were: (1) to review the present data collection and utilization practices by small ruminants breeders in the Latin American and the Caribbean region, (2) to identify a set of minimum essential data related to small ruminants breeding for sustainable development, especially for enhancing their resistance to gastrointestinal parasites (GIP), (3) to identify tools needed in the region for capturing and managing data and their effective utilization in sheep and goats breeding, (4) to identify training needs and contents for building regional capacity on small ruminants breeding and parasite control, and (5) to outline the content of a manual for small ruminants breeding to enhance resistance to GIP infections.

Participants at the meeting.

Individual experts presented recent updates on sheep and goat breeding goals and status of breeding programme implementation in the context of the control of gastrointestinal parasites (GIP) and summarized the level of technology uptakes in the small ruminants production in general and breeding in particular in the Latin American and the Caribbean region. Mr Riccardo Negrini shared Italian experiences on the application of a package of animal selection tools involving (1) performance recording, (2) artificial insemination, (3) controlled mating and (4) genetic evaluation that enable breeders tapering off an elite population of males and females selected for breeding in a wider population. Keys to the success of a selection scheme were identified to be links between farms for sharing genetics, optimal mating plan and enhanced evaluation of young rams. A 5-step roadmap was developed to build capacity for the implementation of sheep and goats breeding with focus on GIP resistance. The steps start from basics on survey and situation analysis to the collection of a complete set of phenotypes and genomic data and integration of genomic and phenotypic data in breeding decisions using association methods. A list of phenotypes for running breeding programmes in sheep and goats were identified and classified. Current methods, application of tools and practices of phenotype collection were analysed and found that except Argentina, Brazil and Uruguay, the other seven countries participating in the project will have to start from the basics of data collection and it was agreed that prescribed forms will be used for field data collection and data will be stored in customized Excel sheets. Training needs were identified in seven areas: (1) genetics of parasite resistance in sheep and goats with emphasis on sampling and data collection, analyses and reporting; (2) health management of small ruminants including parasites control; (3) assisted reproductive techniques including oestrus synchronization

and artificial insemination; (4) genetic evaluation and breeding practices; (5) animal nutrition, feeding and management; (6) statistical methods and interpretation of results for the analyses of data for genetic evaluation; and (7) writing scientific articles. Objectives and contents of all training topics were described. Contents of a manual for guiding sheep and goat breeding for parasite resistance were described and potential writers of individual chapters were identified.

It was considered of high importance that national counterpart teams engage farmers and breeders with the project and share project objectives, activities and expected outputs to give an ownership of the project to stakeholders. The meeting recommends that counterpart institutes are supported by IAEA for continued and sustainable capacity building on improving livestock productivity. The meeting was attended by five experts: (1) Mr Mario Poli (Argentina, Italy), (2) Mr Jose Fernando Garcia (Brazil), (3) Mr Victor M. Montenegro (Costa Rica), (4) Mr Riccardo Negrini (Italy) and (5) Ms Virginia Goldberg (Uruguay). Mr Marcos Medina, Vice-Ministro de Ganadería officially opened the meeting. He also attended the concluding session. Mr César José Cardozo Román, the National Liaison Officer (NLO) of Paraguay to IAEA remained present in the opening and the closing sessions. Seven local participants attended the meeting.

Regional Training Course on Enhancing Capacity of National 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 regional training course on biosafety in the field took place at the National Veterinary Laboratory (LANAVET) from 19 to 23 September in Yaoundé, Cameroon.

It was organized by Dr A. Wade with three lecturers and 15 participants from six French speaking African countries (Burkina-Faso, Central African Republic, Mali, Togo, Democratic Republic of Congo and Cameroon). The main purpose of the training course was 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). In lectures, demonstrations and practical exercises, all participants learned to apply proper personal protection, work in PP equipment and how to collect field samples and disinfect a potentially contaminated site. Finally, the requirements for shipment under biosafety regulations and the lessons learned during the EBOLA and avian influenza crisis in African countries were discussed.

At a final ceremony, the certificates were handed over by the Cameroon Minister of Livestock, Fisheries and Animal Industries.

Tropentag 2016

The Workshop on Community-Based Livestock Breeding Programme in Tropical Environment took place on 19 September 2016 at the University of Natural Resources and Life Sciences (BOKU Vienna), Austria.

Participants at the workshop.

As part of Tropentag 2016 – International Conference on Research for Food Security, Natural Resource Management and Rural Development, half a day workshop was organized on 19 September 2016 on the application of community-based approaches to strategize animal breeding in low-input production systems as prevailing in the tropical countries. The workshop was jointly organised by BOKU, the Joint FAO/IAEA Division of the International Atomic Energy Agency – NAFA-APH, the International Livestock Research Institute (ILRI), and the International Centre for Agricultural Research in the Dry Areas (ICARDA). Four resource persons, Ms. Maria Wurzinger from BOKU, Mr Kathiravan Periasamy from NAFA-APH, Mr Okeyo Mwai from ILRI and Mr Aynalem Haile from ICARDA made keynote presentations. This was followed by a general discussion. Forty one participants attended the workshop. Mr Mario Garcia Podesta and Mr Mohammed Shamsuddin jointly

acted as moderators of the Workshop. The Workshop outputs are summarised below:

Challenges: Animal breeding programmes are challenged by policy barrier; Infrastructures are lacking, investments are minimum and farmers are not empowered; Poor/weak institutional capacity that lacks data automation system and facilities for performance recording.

Actions: Define characteristics and limitations of low input systems of animal production; Ensure community participation and empowerment in the planning of the animal breeding**;** Create an enabling environment for the community to make breeding decisions**;** Select a few traits at a time and set few nucleus herds as part of the breeding programme; Develop breeders association**;** Engage the youths in recording pedigree and progeny performance and in understanding the value chain of the local animal production**;** Ensure smart application of information and communication technologies; Record 10-15% animal of the target population along the breeding goals as a minimum requirement.

Tools: Select appropriate participatory tools to get farmers reflections and information on breed choices that fit in the production system and environment**;** Identify what to record, just what is essentially needed**;** Focus on the automation of data collection and feedback

Way forward: Ensure community voice in addressing any external intervention; Present case study results to farmers to aware them that the 'Big and Exotic' is not necessarily the most profitable livestock species or breed**;** Eliminate policy barrier and develop supportive policy; Part of revenues collected from trading livestock produces should be used for performance recording of animals where it has not yet been started; Index-based livestock insurance (disaster-health service) could be initiated; In crossbreeding address animals' adaptability together with level of exotic blood, production goals and inputs mobilised; Link molecular genetic tools where applicable, especially when a cost-benefit analysis supports an informed decision.

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

Technical Officers: Mohammed Shamsuddin, Mario Garcia Podesta

The first RCM took place from 3 to 7 October 2016 in Vienna, Austria. Ten research contract holders (RC) and four agreement holders (RA) attended the RCM.

The objectives of the meeting were to (1) enable individual Research Contract Holders (RCH) share their national data on cattle breeding programmes, artificial insemination (AI) for genetic improvements and on the practice of genomics; (2) share the state of the art on the application of genomic and AI in dairy cattle breeding from Agreement Holders (AH) institutes and from the APH Laboratory; (3) discuss and agree with project objectives, methodologies and work-plans and identify needs for protocols, SOPs and guidelines to produce a uniform set of data; (4) discuss and finalise work-plans of individual research contracts; (5) identify way forward to increase connectivity and training and additional funding opportunities.

Individual RCH presented their country data, project objectives and work-plans. It appeared from the presentations that in Argentina, China, Kenya, Peru, Serbia, South Africa and Tunisia, AI is performed with semen from purebred bulls. Bangladesh and Sri Lanka use crossbred bull to breed indigenous and crossbred cows and heifers aiming at maintaining a combination *of Bos taurus* and *Bos indicus* blood level that suits in their production system. Holstein, Brown Swiss, Jersey and Tarentaise were the major sire breeds reported. Based on dairy cattle breeding history, Argentina, China, Peru, Serbia, South Africa and Tunisia were considered likely to have bulls from North American or European Holstein sire lines. Some of these countries mainly use imported frozen semen in high-input better managed herds while semen from local bulls is often used in cows that return and require additional services for conception and those at low-input milk production system. Kenya selects bulls from local herds; therefore it was cautiously considered that apparently looking 'purebred' Holstein needs to be genotyped to confirm the level of genetic admixture, if any.

RCM participants and organizers.

The work plans were updated and common research methodologies were developed according to the CRP objectives. Meeting participants agreed with phenotypes to be recorded, which are related to the environment, farm and cattle (including parturitions, services, milk yield, growth, and productive diseases). Phenotypic data of at least 1000 cows and of at least 20 local bulls per population per country will be recorded in a database.

Two major lines of research work were agreed on: (1) Countries (Bangladesh, India, Kenya, South Africa, Sri Lanka) that are conducting crossbreeding will aim at admixture analysis to assess the distribution of genetic

groups of crossbreds, evaluate their performance and identify suitable genotypes for the prevailing production systems; (2) Countries (Argentina, China, Peru, Serbia, Tunisia) that are keeping purebred taurine populations will work to estimate PTAs of sires under the local conditions will be correlated with genomic PTAs of sires in USA/Canada and EU. The level of recording performance data in participating countries varied widely. Initiatives should be taken to enhance the recording system by implementing appropriate tool and guidelines in line with guidelines of the International Committee for Animal Recording (ICAR). The level of skills on conventional genetic evaluation was generally low in participating countries. Trainings and technical supports were recommended for building human capacities on quantitative genetics, genomic tools and data interpretation. Data capture tools and database will be developed for phenotypic data entry and make them available to RC holders by early 2017.

Technical Workshop: Remediation of Radioactive Contamination in Agriculture

Technical Officers: Carl Blackburn, Gerd Dercon, Ivancho Naletoski, Stephan Nielen, Zhihua Ye

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

The year 2016 marks the fifth anniversary of the accident at the Fukushima Daiichi nuclear power plant (NPP) and the 30th anniversary of the accident at the Chernobyl NPP. A Technical Workshop on Remediation of Radioactive Contamination in Agriculture was co-organised by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and the National Agriculture and Food research Organization of Japan (NARO) and held at the IAEA headquarters, Vienna, Austria from 17 to 18 October 2016. Over 100 experts from around the world participated in the event and all of the presentations and discussions focused on research results and practical experience from Japan and from countries affected by the Chernobyl NPP accident. This was a great success in promoting and sharing knowledge and experience related to remediation of radioactive contamination in food and agriculture. Copies of the presentations are now available online at http://www-naweb.iaea.org/nafa/news/2016-FAO-IAEA-NARO.html. From an agricultural perspective, the impacts of both these major accidents are related to caesium radionuclides, specifically caesium-137, which is a relatively long lived isotope with a half-life of some thirty years. Research and technical efforts to remediate and ameliorate the impact of this radioactivity on agricultural production aim to minimize and prevent the contamination of foods and other commodities, and further to assist the social and economic recovery of affected rural communities by enabling sustainable production. However, these efforts are not widely appreciated outside of the affected areas.

The two day event commenced with opening statements from representatives of the three host organizations: Mr Aldo Malavasi, Deputy Director General of the IAEA; Mr Qu Liang, Director of the Joint FAO/IAEA Division in representation of FAO and Mr Imbe Tokio, President of the National Agriculture and Food Research Organization (NARO) of Japan.

The organizers would like to thank all the workshop participants, especially those who provided technical contributions. In recognition of the high level of interest in this technical area, the Joint FAO/IAEA Division and NARO have entered into a practical agreement for mutual collaboration, view of holding similar events in future.

National Training Course on Artificial Insemination and Delivery of Reproduction Enhancement Services on Farm (BEN5010/001)

Technical Officers: Mohammed Shamsuddin

The training course took place from 24 to 29 October 2016 at Kpinnou, Benin.

Training course participants.

The objectives of the course were to provide on-site, hands-on, intensive training to technicians and professionals engaged in cattle production on (1) better understanding of female reproductive physiology, gynaecological evaluation and the improvement of herd-level fertility; (2) increasing skills on doing artificial insemination (AI) and pregnancy diagnosis; and (3) effective implementation of AI field services for genetic improvement. The training course was organized jointly by the Faculty of Agronomic Sciences (FSA) of University of Abomey-Calavi (UAC) in Cotonou and Kpinnou Breeding Farm of the Livestock Department, Ministry of Agriculture, Livestock and Fisheries of Benin.

The International Atomic Energy Agency appointed an external lecturer, Dr Naceur Slimane, École Nationale de Médecine Vétérinaire (ENMV), Tunisia. The local organizers were Mr Mankpondji Frederic Houndonougbo from FSA and Dr Athanase Ahissou from the Livestock Department. The course was attended by 19 participants from Agent Communal de Contrôle des Produits d'origine Animale, Technicien Spécialisé en Production Animale and Faculty of Agronomic Sciences. Theoretical lectures, practical demonstrations and hands-on practices were conducted at the Kpinnou Breeding Farm. The theoretical presentations covered the anatomy of the reproductive tract of cows, physiology and control of sexual cycle, pathological condition of genital tract (e.g. metritis) and functional abnormalities, for examples, anoestrus and extended post-partum period, ovarian cysts, repeat breeding, etc.), assisted reproductive techniques used for cattle breeding, especially good and hygienic practices of AI and 'wrong doings' in AI. Management techniques involving routine gynaecological examination for evaluation of breeding soundness and diagnosis of early pregnancy were discussed. Presentations were also made on the control of bovine mastitis included milking hygiene and environment and application of California mastitis test.

Practical sessions.

Four practical sessions were conducted to holistically cover AI in cattle. Participants practiced examination of cows for general and reproductive health. At first several excised genital tracts of cows were used to demonstrate to and allow practices by the participants. Participants identified different parts of genital organs of a cow and palpated different organs to get familiar and able to differentiate the feelings related to compositional differences of organs. They exercised passage of AI guns through the cervix. This was done to develop their primary required skills for doing AI in a cow. Then they practiced transrectal palpation of female genital organs, recto-vaginal technique of AI and vaginoscopic examination.

Pilot Networking Meeting (RAF5073/03/01)

Technical Officers: Ivancho Naletoski, Hermann Unger

The Networking Meeting took place at the Pasteur Institute in Abidjan Côte d'Ivoire from 8 to 11 November 2016 under the Technical Cooperation Project 'Strengthening Africa's Regional Capacity for Diagnosis of Emerging or Re-emerging Zoonotic Diseases, including Ebola virus disease (EVD), and Establishing Early Warning Systems' RAF5073. Twenty representatives of the veterinary and public health authorities and laboratories from Burkina Faso, Central African Republic, Chad, Ethiopia, Cameroon, Mali, Niger, Togo attended the meeting, that aimed at strengthening the One-Health initiatives and the coordination mechanisms in the region.

The participants were discussing the recent outbreaks of multiple zoonotic diseases in the region, such as the highly pathogenic avian influenza in Central and West Africa, the monkeypox and rabies epidemics in Central African Republic, surveillance plan for Ebola in Côte d'Ivoire, outbreaks of Rift Valley fever in Niger and other emerging zoonotic diseases in the region, as well as the requirements for coordinated response under the developing One-Health umbrella.

Participants and meeting organizers.

The participants emphasized the immediate need of capacity building in: i) standardization of the sampling protocols, sample delivery to the local laboratories (transport) and access to the services of the regional reference laboratories, ii) standardized protocols for wildlife capture and investigation, iii) targeting selected pathogens in the potential environmental carriers (flora and fauna) in surveillance plans, iv) establishment of monitoring system for people at risk following the outbreak of emerging and re-emerging diseases and v) the establishment of technical committees in the level of Ministries for top-to-bottom and bottom-to-top coordination of the actions.

There was an action plan for the whole region produced, considering the specific needs of individual member states taking part in the project.

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 at transferring 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.

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.

Partners from Bulgaria, China, Russian Federation, Tajikistan, Turkey, Republic of Korea, United Kingdom and Germany have attended and discussed the progress of the project and results obtained.

Several hundreds of samples from wild birds (feathers and fecal or cloacal swabs) were collected and multiple avian influenza viruses were identified by the project partners. However, the core activity in the project was to evaluate the possibility of the use of stable isotope ratios in feather samples of wild birds for determination of the bird origin (Figure 1). This approach offers the possibility to trace back the origin of a sampled wild bird, once it is determined as carrier of the avian influenza viruses, which is almost impossible to achieve when using radio locators or GPS devices, because the likelihood that exactly the tagged bird will carry avian influenza viruses is minimal.

Additional contribution of the project was the establishment of standard operating procedures for DNA barcoding of the fecal and feather samples which enables

Partners in the CRP D32030 during the 3rd RCM in Sofia, Bulgaria.

for determination of the bird species with 100% accuracy in vast majority of the bird species. The technique allows for establishment of non-invasive surveillance systems, where only fecal and feather samples are sufficient to determine the species and the status of virus carrier (through the fecal samples), as well as the species and the stable isotope profile (bird origin) without even capturing the bird.

The calibration of the stable isotope ratios for each individual bird species was performed using the Global Network of Isotopes in Precipitation (GNIP) maintained by IAEA (Figure 2).

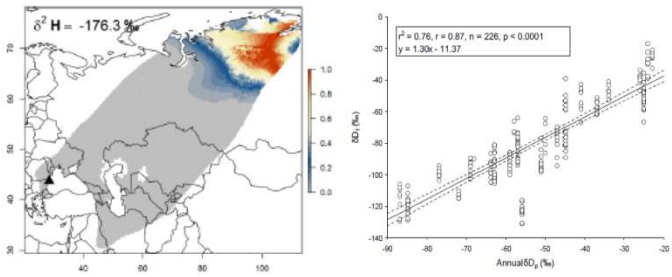


Figure 1: Assigning the probability of origin of the migratory birds, based on the stable isotope ratios in the bird feathers (in the example Red-Breasted Goose – Branta ruficollis) sampled at the eastern coast of the Black Sea).

Figure 2: Calibration chart for stable isotope ratios (deuterium) based on the IAEA GNIP database.

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

Mr G. Cattoli, APHS, was invited to make a presentation. Please find here following a short abstract of this presentation.

Avian influenza viruses at the animal human interface: Progress and challenges in under resourced countries

Before the emergence of the Avian Influenza (AI) H5N1 panzootic in 2003, highly pathogenic AI (HPAI) was considered an uncommon disease of poultry in many countries worldwide. However, in the last 15 years infections caused by HPAI zoonotic viruses belonging to the H5 and H7 subtypes have increasingly been reported in Africa, Australasia and the Americas, including many under-resource countries, where these viruses had never been detected before. Therefore, many countries were found completely unprepared and with limited technical and financial resources to properly face the emergence and spread of AI infections, which implied severe economical and public health potential threats. This prompted both governmental institutions and international organizations to promote research, mobilize resources and take actions to strengthen public health and veterinary services in under resource countries, particularly in Africa and Asia where HPAI virus infections have become endemic in some areas. The presentation highlighted the progress made to combat HPAI in these countries, as well as the challenges that still exist for an efficient control of disease.

Workshop on Advanced Diagnosis and Control of Emerging Transboundary Animal Diseases, with Emphasis on Lumpy Skin Disease (RER9137/9003/01)

Technical Officers: Ivancho Naletoski, Charles Lamien

The training course was held from 21 to 25 December 2016 IAEA Headquarters in Vienna, Austria.

Fifty three participants from the IAEA European region, together with 20 guests and observers from the IAEA non-recipient countries have attended the course, supported by the 10 invited international experts.

Lumpy skin disease (LSD) is a very contagious viral disease of cattle, caused by a capripoxvirus and transmitted by direct and indirect contact, as well as by vector arthropods. The disease causes significant production loses in cattle breeding and is quite difficult to eradicate. Until recently the disease was present in Africa and parts of Asia. However, it was considered as an exotic disease in Europe.

During 2013 the disease emerged in Turkey and has rapidly entered to the European mainland, in Greece, Bulgaria, the Former Yugoslav Republic of Macedonia, Serbia, Albania and Montenegro, causing more than 1200 outbreaks during 2016.

Participants at the workshop on LSD at the IAEA Headquarters.

The laboratories of the affected European Member States did not have major experience in the use of techniques for detection of the disease. The Animal Production and Health Section of the Joint FAO/IAEA Division has rapidly reacted to the situation, organizing two training courses aimed on dissemination of the advanced nuclear and nuclear related techniques for detection and differentiation of the capripoxvirus, simultaneously supplying the participating laboratories with appropriate emergency diagnostic toolkits for immediate implementation.

The rapidity of spread of the LSD however, was demanding immediate integration of the diagnostic techniques into the control plans of the affected countries. Moreover, it became necessary to implement vaccination in order to stop the further spread of the disease. Current vaccines are based on the use of life attenuated strain of the LSD virus; therefore the control of the disease should be supported by diagnostic tools able to discriminate between the field infection and the vaccine strain.

In order to facilitate the understanding of the complex epidemiological circumstances of LSD spread and control, as well as to integrate a wide panel of nuclear and nuclear related techniques for virus detection and differentiation into the control plans, IAEA has organized a workshop, inviting the most relevant experts with long term experience from all over the world, to share the most updated scientific knowledge in the field, with European colleagues.

The topics of the workshop were divided in 5 thematic areas: i) General overview and the experiences with the EU outbreaks; ii) Diagnosis and vector surveillance; iii) Novel technologies for the detection of animal infectious diseases; iv) Vaccines, vaccination and control measures, and v) Preparedness and response to LSD outbreaks.

Representatives of other international organizations such as FAO and EFSA, as well as the representative of the European reference laboratory for capripoxvirus infections have contributed with presentations.

Training Course on Genetics of Parasite Resistance in Sheep and Goats: Sampling, Data Collection, Management and Analyses

Technical Officers: Mohammed Shamsuddin, Kathiravan Periasamy

The training course took place during 5–9 December 2016 in Cane Lones and Montevideo, Uruguay.

Gastro-intestinal parasitic (GIP) infection is a major constraint for sheep rearing in Latin America and the Caribbean, particularly with increasing concerns of anthelmintic resistance among parasites. Alternate parasite management strategies including breeding programs that enhance the genetic potential for host resistance will help to alleviate this problem in the long term. To facilitate this, an ARCAL regional Technical Cooperation Project was initiated (RLA5071) to implement breeding programs that focus on improving genetic potential of locally available small ruminants for enhanced parasite resistance characteristics. The objectives of the training course were:

- To enhance knowledge, skills and capacity of the participants in implementing animal identification system for sheep and goat breeding
- To train participants on sampling and phenotyping procedures related to parasite resistance characteristics in sheep and goats
- To improve the ability of the participants in applying database application for storage, retrieval and analysis of genetic data in sheep and goat breeding programs.

The course was organised by Instituto Nacional de Investigación Agropecuaria (INIA), Canelones and Montevideo, Uruguay. Ms Virginia Goldberg, INIA, Canelones, Uruguay was the Course Director. Mr Kathiravan Periasamy from NAFA-APH and seven lecturers from INIA (Ms Virginia Goldberg; Mr Oscar Correa; Mr América Mederos; Mr Daniel Castells; Mr Diego Gimeno; Mr Gabriel Ciappesoni; Ivo Martins-Allflex Brasil) were instructors in the course.

A total of 29 participants from 11 countries (Argentina, Bolivia, Brazil, Costa Rica, Cuba, Dominican Republic, Mexico, Paraguay, Peru, Uruguay and Venezuela)

attended the training course. The training course included theoretical lectures and practical trainings on animal identification using an ear tag system that simultaneously allows collection of samples for genetic analysis. Biological cycle, epidemiology and distribution of gastro-intestinal parasites infecting sheep and goats and their strategic control measures were discussed. Various phenotyping procedures related to parasite resistance characteristics in small ruminants, including estimation of

Animal identification tool kits distributed to participants.

fecal egg count, packed cell volume and FAMACHA scoring (a method to assess anemic level and parasite burden in animals) were covered during the training course. GLIDMaS (Genetics Laboratory Information and Data Management System) developed by APH team was also introduced to the participants and installation procedures demonstrated. The participants were trained to use the 'Genetic Repository' module (data entry, import, search and report facilities) for managing information on samples collected to assess parasite resistance in sheep and goats. The training course also covered practical procedures on extraction and quantification of DNA for the purpose of genotyping small ruminants (sheep was used for practical exercise) using various molecular markers. The objectives of the training course were successfully achieved and each of the participating country was provided with 'Animal Identification Toolkit' to enable sampling and phenotypic data recording in at least 500 sheep or goats. It is expected that the training will help the ongoing regional efforts in the Latin American and Caribbean countries towards implementing appropriate sheep breeding program as one of the alternate strategies for the control of gastro-intestinal nematode parasites.

Hands on practices on animal identification and sampling(Left) and DNA extraction (right).

Qualified lecturers, logistics, class room facilities, training materials and excellent management and hospitality provided by INIA were highly regarded, appreciated by the participants and thankfully acknowledged.

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

Technical Officers: Charles Lamien, Bharani Settypali, William Dundon

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

The purpose of this training was to promote the application of advanced rapid and differential diagnoses of multiple pathogens in the targeted African and Asian veterinary laboratories and strengthen the participants' countries capacity 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.

The training consisted of lectures on the principles and practical sessions on the applications of molecular and serological diagnostics, differential diagnostics and molecular epidemiology for PPRV, capripoxvirus and other ruminant pathogens. Twenty participants from 19 African and Asian countries attended this training course.

Stories

Mongolia Keeps Animal Diseases at Bay with the Help of Nuclear Technologies

A portrait of life in Mongolia is not complete without livestock. For city dwellers and nomads alike, more than 70 million animals are an essential source of food, income and cultural symbols for this country of barely three million inhabitants. Yet livestock owners like Batbaatar Chuluun are calm about highly contagious animal diseases. That's thanks to Mongolia's comprehensive animal disease control system built in part with support from the IAEA, in cooperation with the Food and Agriculture Organization of the United Nations (FAO).

"I don't worry about my animals or the diseases. If my animals get sick, the local vet will come and help me and will know what to do. I know the government is ready and can help," said Chuluun, a nomadic farmer from just outside the capital city Ulan Bator, who owns a few hundred cattle, goats and sheep. He relies on the meat and milk of these animals for his income and for feeding his family.

For decades, scientists and veterinarians in Mongolia have been trained and equipped by the IAEA and the FAO. Through this support, veterinarians have learned how to correctly take samples and manage potentially infected livestock, and scientists have acquired the skills and tools to use nuclear and nuclear-derived techniques to quickly and accurately analyse these samples (see The Science box).

Animal diseases, such as foot-and-mouth disease (FMD), peste des petits ruminants (PPR) and brucellosis, can easily spread to livestock through direct contact with wild animals, as well as through the air or contact with foodstuffs and objects contaminated by an infected animal. Their effects can range from lameness to death. These diseases are at times linked to infected meat and animal products, which causes many countries to impose trade restrictions to minimize the risk of potentially importing a disease.

"When an animal disease strikes, we're well-trained and ready to respond fast," said Batsukh Zayat, Lead Veterinary Scientist at Mongolia's Institute of Veterinary Medicine. "We know how to work together at all levels to quickly enact emergency response plans, effectively analyse samples and distribute vaccines to minimize the spread of a disease."

Animals on the move

Fast and accurate diagnosis is critical in Mongolia where nearly all of the livestock roam free and graze off the land, explained Bandi Tsolomon, Head of the Veterinary Division and Chief Epidemiologist at the Implementing Agency of the Government of Mongolia for Veterinary and Animal Breeding.

Risk of contamination is further exacerbated by the nomadic lifestyle of around half of the Mongolian population who care for the majority of the country's livestock. Nomadic people move on average four to five times per year to ensure their animals have sufficient land for grazing.

Put to the test

Mongolia's animal disease control system was put to the test during a major FMD outbreak in September 2010. The country was struck by a severe case of this infectious disease that affects cloven-hoofed animals — those with hooves split into two toes — such as cattle, sheep, goats and antelopes.

"At the time of the outbreak, we had to cull more than 25 000 animals, while many more fell sick," explained Zayat. Through the decades of close collaboration with the IAEA and the FAO, Mongolian scientists and veterinarians had the training and equipment they needed to quickly respond to the epidemic.

Once farmers and local veterinarians spotted the sick animals, they quickly quarantined them and took samples. These samples were first analysed at provincial labs and then sent for further analysis to the veterinary scientists at Mongolia's State Central Veterinary Laboratory (SCVL). They used nuclear and nuclear-derived techniques to detect and evaluate the virus strains and to determine which vaccines to use.

evolve over time, which means a vaccine that may have worked for one virus strain, may not provide sufficient protection for another virus strain, even if they are similar," explained Gerrit Viljoen, Head of the Animal Production and Health Section at the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. A strain-specific vaccine becomes necessary when a standard vaccine is no longer providing full protection.

Mongolian officials and scientists worked directly with the Joint FAO/IAEA Division to trace and procure the most suitable vaccine from a supplier in France. Within three months of getting the vaccine, the outbreak was contained.

Mongolia's control system continues to perform. Most recently, PPR crossed borders into Mongolia for the first time, affecting at least four provinces. Scientists at SCVL were able to quickly identify the pathogen, and Joint FAO/IAEA Division scientists quickly confirmed the findings.

These findings immediately triggered prepared intervention plans that involved monitoring herds and separating infected animals from non-infected animals. The early and rapid diagnosis of PPR allowed Mongolia to effectively gain control of the disease before it could spread.

Regaining lost export ground

As animal diseases continue to be controlled on a local level, officials are now also using the animal disease control system as a springboard for re-establishing the country's position in export markets as a source of high quality meat.

Historically, Mongolia exported approximately 150 000 tonnes of animal products per year. Due to animal diseases, its export market shrank as countries have grown concerned about the spread of diseases potentially affecting the quality of the products.

Mongolia's export potential remains at just under 150 000 tonnes per year, but the country only exports on average less than 10 000 tonnes annually. This equates to around $600 million in lost revenue compared to before.

But the situation is now changing as Mongolian officials use the animal disease control system to build confidence in the country's products. This includes establishing and maintaining zones free of FMD. "We now have an area with three zones: one that is free of FMD, another that is a buffer zone, and the third is a vaccination zone. By having this system, we have been able to open up exports from the FMD-free zone to neighbouring countries. We hope to continue this trend and continue to grow our export market again," Tsolomon said.

Scientists are also actively working to prove other diseases have never been present in the country and that their country meets World Organisation for Animal Health (OIE) standards. These standards play an important part in international trade.

"Now with the tools and equipment we have, we are making steady progress to gain back lost markets," Zayat said.

The Science

ELISA The enzyme-linked immunosorbent assay (ELISA) and polymerase chain reaction (PCR) are two nuclear-derived techniques commonly used for detecting diseases in animals.

is easy to setup and use, which makes it suitable for smaller veterinary laboratories, like those found at regional level in Mongolia. Scientists place a serum sample from an animal on a prepared dish and if the sample contains the suspected disease, it causes the enzymes on the dish to change colours confirming the presence of the disease. ELISA is often used for initial tests, but it has a limited sensitivity and specificity and cannot be used to identify virus strains.

PCR is a technique involving more equipment and procedures than ELISA, but it is highly sensitive and accurate, making it well-suited for identifying virus strains and bacteria. This technique is used to replicate, or amplify, a specific region of pathogen (such as a virus or bacteria) DNA billion-fold in just half an hour. Scientists then detect and monitor this target DNA amplification through either radioisotopes or by counting fluorescent molecules.

Both methods originally worked with radioisotopes and now apply enzymes instead, which has helped to streamline the testing process.

https://www.iaea.org/newscenter/news/mongolia-keeps-animal-diseases-at-bay-with-the-help-of-nuclear-technologies

Working Towards Food Safety and Animal Health in Morocco

An IAEA technical cooperation project[1] supported by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, has greatly enhanced the capacities of Morocco's national veterinary laboratories to detect veterinary drug residues and animal diseases. The project, initiated in January 2014 at the request of the government of Morocco, was designed to support the work of Morocco's National Office for Food Safety (ONSSA).

Morocco's geographical location right at the crossroad between the Mediterranean and Central Africa exposes the country to a higher risk of the introduction of animal diseases. These can threaten animal health, meat production capacity and the country's ability to export meat products, as well as public health (considering zoonotic diseases). Morocco urgently needed to be able to detect infectious animal diseases such as foot-and-mouth disease, bluetongue, African horse sickness and African swine fever, rapidly, including diseases with zoonotic potential such as brucellosis, tuberculosis, rabies and others. Veterinary drugs and other agrochemicals are needed to control these diseases. However, since residues of these chemicals may end up in animal products, laboratory analytical capabilities to monitor the residues and assure consumers were equally urgently required.

ONSSA was established in 2010 to support the goals of the Morocco Green Plan (Plan Maroc Vert, PMV), an agricultural strategy introduced in 2008 to combat poverty and hunger by improving national agricultural performance and output. ONSSA is responsible for national regulatory matters related to food quality and safety, as well as animal and plant health. Recent investments by the ONSSA in veterinary laboratories have aimed to enable better control of food products under the Moroccan Veterinary Drug Residue Monitoring Plan (VDRMP), which was also established under the PMV.

Although the Moroccan veterinary laboratories were equipped with real time polymerase chain reaction equipment used to detect and analyse specific pathogens' RNA or DNA, local staff needed suitable training in order to make maximum use of the high tech equipment available. In addition, the speed at which technologies were evolving (enabling shortening of detection time, essential for early and rapid detecting of infectious diseases), meant that personnel required training in state-of-the-art diagnostic and detection techniques. This would make it possible to significantly shorten analytical times, and increase the number and types of diseases detected. The same is applicable in the food safety area. Immediate Agency support was required for human resource development.

Through the IAEA technical cooperation project, support was provided to ensure the effective use of relevant analytical and diagnostic equipment. Laboratory personnel were trained (with the ability to train others) in veterinary drug residue testing and animal disease detection. Capacities in early detection and response to outbreaks such as avian influenza, rabies and others were also significantly strengthened.

As a result of the project, staff at the veterinary laboratories can now identify ten types of veterinary drug residues using isotope based liquid chromatography-mass spectrometry (an increase from the three types that could be detected prior to the start of the project). This means that the laboratories can cover the whole range of residues including restricted substances. The liquid chromatography-mass spectrometry technique separates and detects chemicals in other substances, making it essential for residue detection and "fingerprinting"[2]. The number of accredited drug residue and animal disease detection methods used in Morocco according to the ISO 17025 standard[3] has more than doubled since 2012.

Today, the Moroccan government is able to better implement its national drug residue monitoring plan using high level analytical standards that meet international guidelines and those of major trade partners. This has enhanced food safety levels in the Moroccan market and will support plans to export poultry products.

In the field of animal health, the awareness of laboratory analysts regarding quality assurance and quality control in molecular biology analysis was greatly improved. The

analysts participated in the diagnosis of the first outbreak of H9N2[4] in Morocco in early 2016.

Overall, the project has strengthened networking between laboratories, both in Morocco and internationally, that are working on chemical contaminant analysis and molecular biology diagnosis. In the long run it will contribute greatly to the country's agricultural export possibilities, and will improve food safety and animal health.

Participants during a workshop on animal diseases in Morocco. (Photo: S. Darkaoui/ONSSA).

BACKGROUND

Since the introduction of the Morocco Green Plan (PMV), Morocco's agricultural sector has experienced a remarkable transformation, with an increase in the cultivated area of 750,000 hectares, a reduction by half of malnutrition (a key MDG target for Morocco), and significant increase in agricultural production and employment[5].

Measures undertaken under the Moroccan Veterinary Drug Residue Monitoring Plan complied with the requirements of the international regulations (like the Codex Alimentarius) and those of Morocco's main commercial partner, the European Union, and should therefore open new markets for Moroccan products.

[1] Project MOR/5/034, 'Improving Veterinary Drug Residue Detection and Animal Disease Diagnosis with Nuclear and Molecular Techniques'.

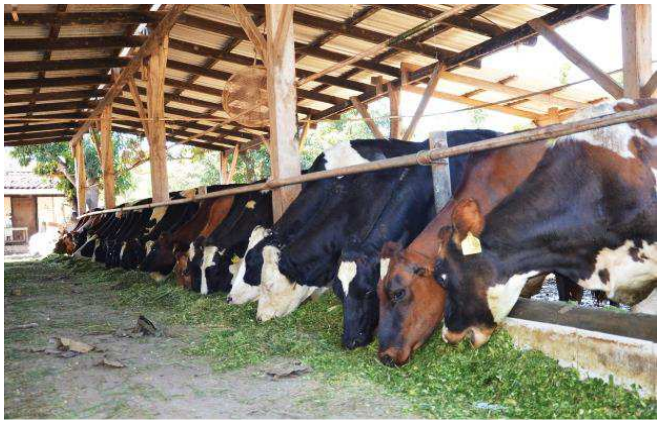
[2] A method used to analyse DNA fragments.

[3] International Organization for Standardization's requirements for the competence to carry out tests and/or calibrations, including sampling.

[4] H9N2 is a type of avian influenza at the human-animal interface, meaning it can be passed on from animals to humans. It is a variety of the virus commonly known as 'bird flu'. http://www.who.int/influenza/human_animal_interface/Influenza_Summary_IRA_HA_interface_25_02_2016.pdf.

[5] http://www.uneca.org/sites/default/files/uploaded-documents/SROs/NA/AHEGM-ISDGE/egm_ge-_morocco.pdf.

A holistic intervention involving a cooling system, feeding with leguminous forages and farm data recording improves cattle productivity and benefits farmers in El Salvador



Cooling increases feed intake and milk production of cows in the tropic.

Milk production of a crossbred cow (a hybrid between a Bos indicus and a Bos taurus) in the tropic would generally fall between 1500 and 3500 kg per lactation although her Bos taurus ancestors would be producing as high as 12 000 kg per lactation in North America, for example. This indicates presence of non-genetic constraints as well in the tropic, which involves, among others, high ambient temperature and humidity, highly lignified fibrous tropical forages and tropical animal diseases. Also production scales are small and technology uptake, for example, good record keeping for the identification of non-productive animals and implementation of appropriate animal husbandry practices to enhance reproduction and production is low.

A team at the University of El Salvador, San Salvador in collaboration with IAEA has been working with farmers to holistically address the challenges that limit production in dairy farms. They implemented an innovative low cost cooling system to reduce heat-stress on cows, improved feeding by the incorporation of leguminous forage with conventional grass-based forages and application of a recording system that has streamlined the management resulting in an increased number of parturitions and total milk yield and milk production per cow.

The team developed methods of cultivation and conservation of a tropical leguminous forage commonly known as cowpea (Vigna Sinensis). Its inclusion in a sorghum silage-based ration of dairy cows helped farmers reducing the use of additional concentrates as protein

sources (from a traditional 17% to 15.5% crude protein in the final diet). This endeavour finally helped farmers reduce cost of milk production by 7-12%. In the animal, the percentage of protein increased in milk while nitrogen excretion in faeces and urine decreased – the interventions proved to be climate smart.

Cowpea is ready to harvest in a demonstration farmer.

Conventionally, fibrous, poor nutritious forages lower ruminal degradation, which leads to less nutrients available for milk production. Farmers often try to increase milk production by adding concentrate (mainly maize and soybean) in the diet but that is not without side effects. Excess protein impairs cows' fertility.

Heat stress prone cows to metabolic diseases like acidosis. As a mechanism of adaptation, cows lower feed intake, which results in lower production. Heat-stressed cows reduce mounting activities as an oestrus sign, which lead to fewer pregnancies and eventually farmers get fewer cows in milk. The team implemented an innovative low-cost cooling system that has not only increased cows' comfort (manifested by normal rectal temperature and breathing rate) but also has increased feed intake, all together resulting in an 8% milk production increase.

Recording is the key to farm management.

There is a say that "if you can't measure it, you can't improve it". The importance of measuring the reproductive performance of the herd can never be overemphasized in the management of a dairy farm. Income of a dairy farm depends on the number of cows in milk and the amount of milk the cows produce. A cow has to give birth before she can give milk. The team introduced a computerised recording system in six farms and already recorded data on 1800 cattle. Analysis of data has helped the team and the farmers to recognise that cow's fertility is poor during the hotter months of the year (June-August). Also illnesses like mastitis, metritis and lameness reduce conception rates and calving to conception intervals.

The project team in participation with farmers is taking this proven technology package to a wider community for scaling-up the interventions and improving cattle production.

How Nuclear Science Helps Botswana Control Animal Diseases, Ensure Food Safety and Maintain its Beef Exports

Lobatse, Botswana – In Botswana, cattle is a way of life. Owning and herding cattle and selling animals for quick cash when money is tight provide the livelihood for much of the rural population and represent an important supplementary income for city dwellers. When in 2008 the European Union (EU) tightened sanitary requirements on beef imports, Botswana's second largest export industry came to the verge of losing its most important and lucrative market: it had neither the equipment nor the know-how to perform the tests required.

Cattle raising is not only the mainstay of the economy of rural Botswana; it is also part of the social fabric. The country's 2 million people own 3 million cattle. (Photo: M. Gaspar/IAEA).

Since then, the use of nuclear and nuclear-derived techniques, introduced with support from the IAEA in collaboration with the Food and Agriculture Organization of the United Nations (FAO), has enabled the country to put in place veterinary and food safety surveillance systems that meet EU requirements and have successfully passed inspections.

It is very important that we can protect our export markets by demonstrating the absence of disease and food contamination thanks to the use of these modern techniques," said Kekgonne Baipoledi, Deputy Permanent Secretary at the country's Ministry of Agriculture. "The economic situation of most farmers has improved as a result."

Beef is the largest non-mineral export commodity of the country, accounting for 3.3% of total exports. In contrast to minerals such as diamond and nickel, the export performance of beef has a direct impact on the livelihood of a large segment of the population, many of whom are small-scale farmers. Botswana has 3 million cattle and 1.6 million goats for its 2 million people. A suspension of Botswana's beef exports to the EU could hurt the country significantly. In 2011, Botswana suspended beef exports to the EU for a short period of six months at an estimated €48 million in lost revenues.

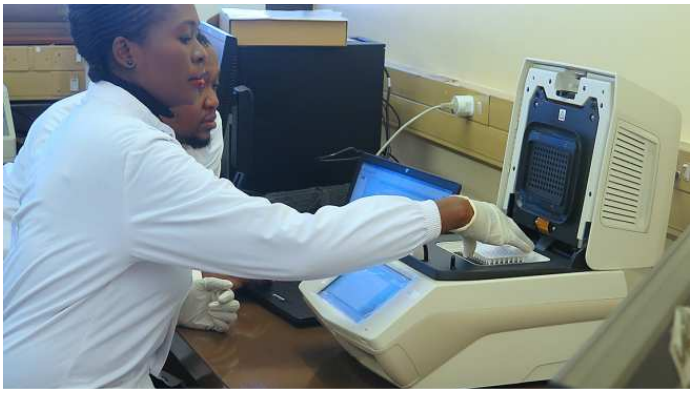
The focus of successive IAEA technical cooperation projects has been to build local capacity in analysis covering an increasingly wider scope of diseases, veterinary drug residues and other contaminants. By the end of this year, the Botswana National Veterinary Laboratory (BNVL) will be able to carry out all of the required tests in-house, and sending samples for lengthy and costly testing in Europe will no longer be necessary, said Chandapiwa Marobela-Raborokgwe, head of BNVL. The lab can now perform tests for 13 different substances. This will reduce costs by over half and lower test turnaround time from around nine months to less than a month.

From cattle to beef: the Botswana Meat Commission currently exports 40 % of its total beef production to the European Union. (Photo: M. Gaspar/IAEA).

Though the country is free from the most dangerous animal diseases, it continuously faces the threat of transboundary animal diseases re-entering from neighbouring countries. Foot and mouth disease is present in the north of the country and could spread to cattle herding areas in the south, which are free of the disease. Conventional disease diagnostic methods are not sensitive or fast enough to provide timely and reliable results, delaying detection and response to outbreaks, said Farayi Chigwada, the chief veterinarian in Mochudi, 40 kilometers north of the capital Gaborone. "By the time you got the results back, the animal has either died or recovered," he said. In 1995, the authorities ordered the slaughter of 300 000 cattle to stop the spread of contagious bovine pleuropneumonia (CBPP), a cattle lung disease that entered from Namibia.

Joseph Wakala is raising 200 cattle at the edge of the Kalahari desert in southern Botswana. Thanks to the veterinary surveillance and food inspection system now in place, the meat from his cattle will be sold at the lucrative European market. (Photo: M. Gaspar/IAEA).

The IAEA, in partnership with FAO, supported BNVL in strengthening its diagnostic capacity by training its staff and introducing modern techniques such as nucleic acid amplification tests and isotopic methods that can detect pathogens in a very early stage of the disease (see Nuclear and nuclear-related techniques used for testing animal diseases and food contaminants). Through its technical cooperation projects, the IAEA supplied equipment and reagents to strengthen diagnostic and surveillance capacities.



Scientists of the Animal Diseases Laboratory of BNVL using a real time PCR machine donated by the IAEA earlier this year to check blood samples from cattle for transboundary animal diseases. (Photo: M. Gaspar/IAEA).

In 2014, authorities managed to quickly stop a local outbreak of Newcastle disease thanks to the veterinary surveillance techniques put in place with the help of the IAEA. "A lot fewer chickens died thanks to rapid diagnosis and early detection," Marobela-Raborokgwe said. BNVL has received recognition as a World Organization for Animal Health (OIE)'s reference lab for CBPP. "We have been able to move from zero capacity just a few years ago to becoming one of only four

reference labs in the world," Marobela-Raborokgwe said, adding that her colleagues are now assisting Angola, Namibia and Zambia in their eradication efforts. BNVL performs tests for neighbouring countries, while at the same time helps them to build capacity, assisting the region to meet its 2030 target date for complete CPBB eradication.

https://www.iaea.org/newscenter/news/iaea-impact-how-nuclear-science-helps-botswana-control-animal-diseases-ensure-food-safety-and-maintain-its-beef-exports

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
D3.20.33	Irradiation of Transboundary animal disease (TAD) pathogens as vaccines and immune inducers	H. Unger G.J. Viljoen

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

Technical Officers: Mohammed Shamsuddin, Mario Garcia Podesta

The CRP aims at enabling Member States (MS) for the application of genetic evaluation and selection involving genomic tools in artificial insemination (AI) programmes for rapid but sustainable improvement of livestock productivity. Ten research contracts (RC) and 3 research agreements (RA) are already awarded. The first RCM was held in Vienna International Centre, Vienna, Austria during 3-7 October 2016. Nine RC holders, all RA holders, one consultant and a representative from FAO attended the RCM. Two major lines of research work are planned, one for those who target crossbreeding and the other for those who keep purebred taurine population. The crossbreeding group will aim at admixture analysis to assess the distribution of genetic groups of crossbreds, evaluate their performance and identify suitable genotypes for the prevailing production systems. The group with purebred taurine populations will work to estimate PTAs (Predicted Transmitting Ability) of sires under the local conditions, which will be correlated with genomic PTAs of sires at their origin. The work plans were updated and common research methodologies were developed according to the CRP objectives. The second RCM will be held in late 2018 aiming at a midterm evaluation of the CRP and finalising work-plans for the rest of the CRP period.

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

The CRP aims at developing 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 this CRP, there are three major laboratory activities planned: (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. Eight research contracts and 3 research agreements are already awarded. The first RCM will be held during 23-27 January 2017 for identifying tools and methods to be adopted, formulating guidelines to be followed and finalising work-plans for 2017–2018.

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 took 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 42 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 project team is comprised of 8 research partners (Argentina, Cameroon, Croatia, Ethiopia, Ivory Coast, The FYR of Macedonia, Morocco and Sudan), two technical partners (France and United Kingdom) and three agreement holders (two from France and one from Australia are in the approval process). The first RCM took place from 15 to 19 August 2016.

Irradiation of Transboundary animal disease (TAD) pathogens as vaccines and immune inducers (D3.20.33)

Technical officers: Hermann Unger, G.J. Viljoen

A recent CRP on the "Evaluation of irradiation for vaccine production" clearly showed, that protection delivered through irradiated pathogen preparations is possible. Specifically the good results obtained with irradiated intestinal and haemo-parasites allows speculations, that one can really induce protection against these. This would be for farmers a big relief as the use of anti-parasitic drugs is expensive, reduces the innate immunity and might lead to resistant strains. As man and animals are both affected by many parasites, this research addresses as well human health.

A recent consultant meeting on immunology agreed, that vaccines against parasites will be a major breakthrough in livestock production as many of these have besides their symptoms and performance reduction an immune compromising effect and thus can lead to other infectious diseases. So far the irradiation of Theileria, Haemonchus and Fasciola were addressed successfully and should be followed up in this new CRP. Theileria annulata trials were successful and the same principle should now be tested with T. parva causing East Coast Fever (ECF). For ECF a vaccine exists, applying infected red blood cells together with Tetracycline, but in ~10% of applications ECF is caused and in another 10% of cases the vaccination does not induce resistance. For Haemonchus contortus the expansion of the stage III larvae will be the major challenge. These irradiated larvae given orally lead to a > 99% protection. But the larvae have to be harvested from infected animals, which might be infected with other diseases. Fasciola hepatica and gigantica are zoonotic parasites, i.e. infect man as well. The preliminary experiments with irradiated larvae showed protection in terms of disease/ symptoms and abolished challenge infections. Here the production of metacercariae is the major problem and should be addressed. An additional topic in this CRP is the evaluation of irradiated pathogens as adjuvants. Gamma-irradiated influenza A viruses have shown their great capacity to induce a cellular immune response. So additional pathogens will be irradiated and their immune response in livestock tested.

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

Animal Genetics

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

Advances in genomics have enabled the development of DNA chips (microarrays) that could be used to evaluate and breed genetically superior livestock for increased productivity. Development of DNA microarrays for animal

evaluation requires sequencing and mapping the genome. Genome maps pinpoint the location of specific features on the chromosomes of an organism and are essential tools in identifying genes responsible for diseases, production and reproduction characteristics. A genome map can be developed either using conventional methods or radio isotopic techniques. Conventional methods of mapping, for example, genetic linkage mapping are based on the natural recombination events and require pedigreed animals in successive generations. In case of livestock, such methods not only involve huge costs and a long time (due to long generation interval), but also result in maps with low resolution. Application of radioisotope techniques help to overcome these limitations by mimicking the genetic recombination events and speeding up the process of genome mapping for faster development of genetic tools to increase livestock productivity. Radiation hybrid panels and genomic tools are not yet available for several important livestock species including camels. Considering the significance of camel improvement for pastoralist communities in Africa and Asia, APHL initiated the construction of radiation hybrid panels for mapping 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".

Figure. (Figure (Left) Irradiation of camel cells for construction of radiation hybrid panels (Right Top) Picking up of live hybrid cells (Right bottom) A colony of radiation hybrid cells for genome mapping.

^{60}Co was successfully used to irradiate two normal diploid fibroblast cultures derived from male and female dromedary camels respectively. Irradiated camel fibroblasts were fused with A23 hamster cells to establish two radiation hybrid panels of different resolutions (15000 rad and 5000 rad). A total of 487 (15000 rad panel - 238; 5000 rad panel – 249) such camel-hamster hybrid cells were collected, of which 279 have been expanded and harvested for subsequent screening with a set of 48 markers. Preliminary analysis revealed retention frequency of camel genome ranging between 10 and 90% across different clones. Further expansion of hybrid cells for harvesting and screening is currently under progress. The final set of radiation hybrid panels selected after screening will be distributed to member states for further characterization and mapping of camel genome. The high resolution radiation hybrid map for camel is expected to help member states in developing and implementing genomic tools for breeding and improvement of productivity.

Estimating levels of admixture in crossbred dairy cattle

Dairy production in tropics particularly in South Asia and Sub-Saharan Africa is essentially characterized by small holder system with an average of about 2-5 animals per household. Genetic improvement of dairy cattle in these small holder systems has been mainly through crossbreeding. The crossbreds have been found to perform optimally with 50% or 62.5% level of exotic inheritance in certain institutional farms. However, such stabilization of crossbreds with desired genetic makeup did not happen at field level due to several reasons including lack of infrastructure for animal identification, performance recording, etc. This resulted in indiscriminate crossbreeding and production of crossbred cattle with widely varying levels of exotic inheritance. These animals currently face several problems related to adaptability, reproduction, and productivity. To address this issue and to assist member states in stabilizing the crossbreds, APHL initiated the development of a low cost DNA marker panel for estimating admixture levels in cattle. A total of 198 samples collected from indigenous and crossbred cattle of Bangladesh and Myanmar were utilized for genotyping with microsatellite and genome-wide single nucleotide polymorphic markers (SNP). All the samples were genotyped for 27 FAO recommended microsatellite markers and 60 000 SNP markers available in a ovine-caprine-bovine array from Affymetrix. Preliminary analysis of microsatellite genotypes included parentage testing and evaluation of admixture levels in indigenous and crossbred cattle. Analysis of SNP genotypes derived from crossbred cattle with varying levels of exotic inheritance is currently under progress.

DNA barcoding for animal and food traceability

DNA barcoding is a method that uses sequence diversity in short, standardized gene regions for the purpose of species identification. In case of animal kingdom, a 648bp long region of the cytochrome c oxidase (COI) gene present in the mitochondrial genome is used as a primary barcode for species identification. DNA barcoding has important applications in food and agriculture and APHL in collaboration with Food and Environment Protection Laboratory (FEPL) is currently supporting the member states through training and technology transfer, particularly on issues related to animal and food traceability. The primary focus of DNA barcoding was to trace (i) wild water fowls that serve as carrier of poultry diseases (ii) fish and edible birds' nest to establish the origin of food.

Animal Health

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

Confirmation of peste des petit ruminants virus (PPRV) outbreak in Mongolia

The State Central Veterinary Laboratory (SCVL) in Ulaanbaatar, Mongolia is an active collaborator of the VETLAB Network funded by Peaceful Uses Initiative of Japan (PUI-Japan) and supported by IAEA. SCVL conducts serological and molecular diagnostics for detection of transboundary animal diseases (TADs) on a routine basis. Forecasting the requirements for combating the outbreaks and handling the surveillance of TADs, SCVL requested support from the Joint FAO/IAEA Animal Production and Health Laboratory (APHL) for the transfer and implementation of advanced laboratory testing methods. Laboratory needs were evaluated and equipment and reagents provided accordingly. An expert visit was conducted for a week during December 2015 to transfer the multi-parametric molecular assays developed at APHL and also identify the needs and gaps for regular conducting of advanced methods. During this visit, the SCVL staff was trained in performing multiplex assays for detection of pathogens causing respiratory diseases in small ruminants and haemorrhagic diseases in swine. As an outcome, SCVL started implementing the multiplex assay for screening respiratory disease affected small ruminants on a routine basis. In August 2016, SCVL successfully identified PPRV infection in samples collected in the southern part of Mongolia. This was the first report on PPRV infection in this country. The rapid test implemented with the support of APH Subprogram enabled the laboratory and the Veterinary Service in Mongolia to promptly notify the infection to the World Organization for Animal Health (OIE). The report of PPR infection was further confirmed by further tests and gene sequencing assisted by an IAEA expert at SCVL. The laboratory in Ulaanbaatar is further collaborating with APHL for virus isolation and whole genome sequencing to understand the molecular epidemiology of reported PPRV isolates. SCVL is also contributing for the validation of multi-parametric assays being developed at APHL, Seibersdorf.

Activities to support Member States in controlling Lumpy Skin Disease

After its introduction into the European Union last year in Greece and this year in Bulgaria, the lumpy skin disease (LSD) has spread into several countries in South East Europe, with serious economic consequences on livestock and trade in Europe. LSD is a virus infection caused by a capripoxvirus affecting cattle. At the time of writing, about 1,000 outbreaks have been officially reported to the ADNS or OIE. The affected countries in Europe are Albania, Bulgaria, Greece, FYR Macedonia, Montenegro and Serbia. Albania, Bulgaria and Serbia have notified the highest number of outbreaks to date. In 2016, LSD also appeared for the first time in Kazakhstan and Georgia after its spread in Armenia, Azerbaijan, Turkey and Russia, in addition to other countries in Central Asia, the Middle East and Africa. In the second semester of 2016, APHL has been conducting several R&D and capacity building activities on LSD and related Capripox viruses in addition to the emergency response described in the previous issue of this newsletter. In particular, a series of events have been organized by APHS in collaboration with the Technical Cooperation Office Europe aiming at increasing the technical capacity in MS and providing up to date information on this disease.

In August 2016, two training courses of one week each were organized at the IAEA Seibersdorf Laboratories. The training focused on the laboratory techniques to rapidly diagnose the infection and on the methods to genetically characterize and confirm the virus. Thirty-six participants from 22 countries participated to these trainings (15-19 and 22-26 August 2016). From November 21 to November 25, 2016 a regional workshop on transboundary animal disease, with special emphasis on LSD, was organized at the IAEA HQ in Vienna. The objective of this workshop was to provide an updated situation of the LSD epidemic in Europe and an update on the current scientific knowledge on LSD pathology, epidemiology, diagnoses and control. Totally, 84 people attended this workshop, including 10 International experts, 54 participants from recipient MS and 20 external observers from European laboratories.

2016 PPR Proficiency Test

APHL has organized a PPR proficiency test for the serological and PCR based detection of PPR. This 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. The panel was shipped to the participating laboratories in August 2016 and APHL has now received the last country data. This year, the PPR PT consisted of a panel of 11 and 10 samples for serological and molecular testing, respectively. Having invited 31 laboratories, 27 laboratories representing 24 different countries in 3 continents participated in the exercise. Laboratories that scored 100% for one or all of the panels received a certificate from the APHL of the Joint FAO/IAEA Division. Additionally, based on the analysis of the results, a general and an individual country report is provided addressing different ways to improve PPR diagnosis.

A novel protocol to measure IFN-gamma release in order to evaluate cell mediated immunity

Cell mediated immunity (CMI) is an important component against infectious diseases especially those are caused by intra-cellular pathogens. CMI induced by the host can be measured by the activation of lymphocytes by assaying two important parameters; the proliferation and production of cytokines by activated lymphocytes. In this context, Interferon (IFN)-gamma production and release from activated T lymphocytes is an excellent indicator of CMI. Indeed IFN-gamma release by T lymphocytes, when pulsed with an antigen is used to detect Tuberculosis (TB) in cattle. Moreover, IFN-gamma production by clonally expanded CD4 and CD8 T cells is a good indicator of CMI induced by vaccinations against many intra- cellular and extra-cellular pathogens. Traditionally, peripheral blood mononuclear cells (PBMC) are isolated and IFN-gamma production is assayed within this cell population. Whole blood assays to measure IFN-gamma release are easy to perform and provide a better response in detecting bovine TB. There are already commercially available kits for this purpose. However, in other situations such as where there is a need to measure IFN-gamma production in CD4 and CD8 cell subsets using flow cytometry or where incubation over several days with an antigen is required the use of PBMC are preferred. In order to address these issues we developed an IFN-gamma release assay using lysed whole blood. We optimized this protocol in sheep and measured IFN-gamma production using both flow cytometry and ELISA. Our protocol is relatively easy to perform in less-resourced laboratories and since there is no need to isolate PBMC it can be performed in shorter time and most importantly, this assay could be performed with a large number of samples. In the framework of the Technical Cooperation Project SUD5036, this protocol has been transferred to Sudan where it was performed and proved to be successful.

Mechanisms of Attenuation in Trypanosoma evansi Infection and the Application of Irradiation Technology as a Tool for Vaccine Development

Recent advances using irradiation in vaccine development against parasitic diseases such as malaria have reignited studies in related parasitic diseases such as trypanosomosis in livestock. The objective of this work is to utilise irradiation to produce living but non-infectious trypanosomes so as to understand mechanisms that are important for establishing an infection. Experiments with irradiated T. evansi parasites reveal receiving irradiation doses above 200 Gy do not recover after exposure whereas those that receive doses below 200Gy recover when regrown as in vitro cultures. Inoculating Balb/c mice with parasites irradiated with doses below 200 Gy leads to an infection that is less virulent when compared to infections initiated with non-irradiated parasites. The RNA profiles of parasites irradiated using different doses at different time points was compared to non-irradited parasites using a microarray platform. Results reveal the up-regulation of 21 genes and the down-regulation of 267 genes when a dose of 200Gy is used for irradiation. The number of genes down regulated when using doses above 200Gy is significantly higher with more than 1200 genes affected signifying 200Gy as the maximum threshold dose that can be applied. Genes that are consistently down-regulated when using doses at 200Gy and below include Metallo-peptidases, Carboxypeptidases, Kinases and members of the Ubiquitin family. Further pathway analysis of the data derived from these experiments reveal that the biological process most significantly associated with low dose irradiation are gene expression, translation and biosynthesis whereas those associated with higher doses include cellular transport and localization. Associated functions for low dose irradiation include ribosomal and structural activity. A summary of pathways affected by different irradiation doses is shown in figure 1. In conclusion, low dose irradiation experiments affect the expression of important trypanosomal proteases that irradiated parasites mitigate for by directing biological pathways towards increased translation and ribosomal activities.

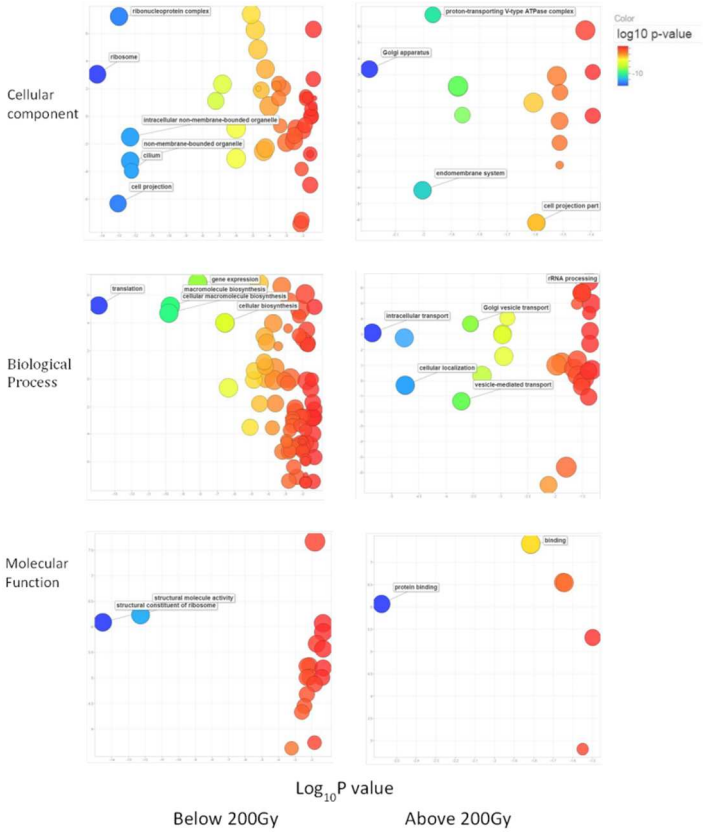


Figure: Gene ontology analysis of irradiated parasites at doses above and below 200Gy. GO terms with associated p values were analysed using REVIGO software (Supek F et al., 2011). Output was assembled into three categories; Cellular component, Biological process and Molecular function. Significance values for different pathways was distributed from high significant, in blue to lower significance, in red.

However, when exposed to doses above the 200Gy threshold, parasites struggle to survive by maintaining nutrient transport processes which ultimately cannot prevent death. Further analysis and experiments looking at protein abundance will help elucidate how irradiation affects processes that are important for establishing disease in the mammalian host.

Fellows/interns/consultants

Ms Anna Gaggl from University of Vienna, Austria was trained on "Construction of radiation hybrid panels for mapping camel genome" for two months (11th July, 2016 to 9th September, 2016) under IAEA internship program.

Mr Amadou Traore from Département Productions Animales, Institut de l'Environnement et de Recherches Agricoles (INERA), Ouagadougou, Burkina Faso was trained on "Analysis of molecular genetic data for characterization of livestock" for two weeks (22nd August, 2016 to 2nd September, 2016) under TC scientific visit (BKF/16025V).

Mr Jayonta Bhattacharjee from Bangladesh Agricultural University (BAU), Mymensingh, Bangladesh was trained on "Genomic analysis of cattle for improvement of milk productivity" for three months (29th August, 2016 to 25th November, 2016) under TC fellowship (BGD/16019).

Ms Anis Nadia Faisol Mahadevan from Malaysian Nuclear Agency, Bangi, Kuala Lumpur, Malaysia was trained on "DNA Barcoding for rapid and accurate species identification of Edible Birds' Nest" for three months (5th September, 2016 to 25th November, 2016) under TC fellowship (MAL/16026).

Ms Hadeel Hussein Abdulameer Al Rubaye from Ministry of Science and Technology, Baghdad, Iraq was trained on "DNA Barcoding for species identification" for one month (21st November, 2016 to 20th December, 2016) under TC fellowship (IRQ/16017).

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 analyze 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.

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) Trainees and staff.

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 that the training will help the ongoing national efforts to complete software for analysis of DNA marker data to assess the genetic diversity and population structure. It is expected the genetic characterization of native livestock breeds in Burkina Faso and Niger.

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
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

TC Project	Description	Technical Officer(s)
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
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

TC Project	Description	Technical Officer(s)
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
HAI/5/007	Strengthening national capacities for the early and rapid detection of Zika virus infections in Haiti **Objective:** To enhance the capacities and support the response to Zika outbreaks through early and rapid detection of patients with Zika virus.	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
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

TC Project	Description	Technical Officer(s)
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
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

TC Project	Description	Technical Officer(s)
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
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

TC Project	Description	Technical Officer(s)
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
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
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
PER/5/032	Conducting Genetic Characterization of Alpacas for Resistance to Diseases **Objective**: To identify genetic markers for resistance to diseases to be incorporated in breeding alpacas.	K. Periasamy, M. Shamsuddin

TC Project	Description	Technical Officer(s)
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
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

TC Project	Description	Technical Officer(s)
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
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

TC Project	Description	Technical Officer(s)
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
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

TC Project	Description	Technical Officer(s)
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

Capripox disease in Ethiopia: Genetic differences between field isolates and vaccine strain, and implications for vaccination failure

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

Antiviral Res.2015. 119: 28-35. doi: 10.1016/j.antiviral.2015.04.008

Sheeppox virus (SPPV), goatpox virus (GTPV) and lumpy skin disease virus (LSDV) of the genus capripoxvirus (CaPV) cause capripox disease in sheep, goats and cattle, respectively. These viruses are not strictly host-specific and their geographical distribution is complex. In Ethiopia, where sheep, goats and cattle are all affected, a live attenuated vaccine strain (KS1-O180) is used for immunization of both small ruminants and cattle. Although occurrences of the disease in vaccinated cattle are frequently reported, information on the circulating isolates and their relation to the vaccine strain in use are still missing. The present study addressed the parameters associated with vaccination failure in Ethiopia. Retrospective outbreak data were compiled and isolates collected from thirteen outbreaks in small ruminants and cattle at various geographical locations and years were analyzed and compared to the vaccine strain. Isolates of GTPV and LSDV genotypes were responsible for the capripox outbreaks in small ruminants and cattle, respectively, while SPPV was absent. Pathogenic isolates collected from vaccinated cattle were identical to those from the non-vaccinated ones. The vaccine strain, genetically distinct from the outbreak isolates, was not responsible for these outbreaks. This study shows capripox to be highly significant in Ethiopia due to low performance of the local vaccine and insufficient vaccination coverage. The development of new, more efficient vaccine strains, a GTPV strain for small ruminants and a LSDV for cattle, is needed to promote the acceptance by farmers, thus contribute to better control of CaPVs in Ethiopia.

Histopathological evaluation of *in vitro* Ichthyophthirius multifiliis culture in red koi (Aka matsuba) tissue

M. Heidarieh, A.A. Shahbazfar, S. Moodi, **H. Unger**, *R. Mohammadi Mavalo*

Bulgarian J Vet Med. 2016. 19: 247-275. doi: 10.15547/bjvm.937

In order to develop any effective means of prevention or therapy against Ichthyophthirius multifilis infection, in this project, the in vitro culture of Ichthyophthirius multifilis trophont containing tissue cysts has been developed. This enables researchers to produce antigens and vaccine and to supply pure organisms without any contamination. Healthy Red koi (Aka Matsuba) tail fin and skin were inoculated into tissue culture media, Leibovitz L-15. The trophonts were exposed to tissue culture within 1 hr after removal from the heavily infected Red koi mucus. Twenty-four hours after introduction of trophonts into tissue (skin) culture, most trophonts observed were adjacent to the basement membrane of the epithelial layer of skin. Additionally, higher numbers of mucous cells in the tail fin epithelium were noted 12 h after trophont introduction into culture. The histological sections of the skin of Red koi (Aka Matsuba) revealed large trophonts of the I. multifiliis after 10 days that were prominently lodged in the

epidermal layers. In this research, the ability to culture I. multifiliis opens new opportunities to develop vaccines, test drugs, and clone parasites for genome sequencing.

First report and characterization of peste des petits ruminants virus in Liberia, West Africa

H. Boussini, Chitsungo, S.C. Bodjo, A. Diakite, N. Nwankpa, A. Elsawalhy, J.R.N. Anderson, A. Diallo, ***W.G. Dundon***

Trop Anim Health Prod. 2016. doi: 10.1007/s11250-016-1101-y

Understanding the molecular epidemiology and evolution of PPR virus (PPRV) can assist in the control of the transboundary spread of this economically important disease. This paper reports the isolation of a PPRV from pathological and swab samples collected from goats in Liberia, West Africa in July 2015. The full genome of one of the isolates was sequenced and phylogenetic analysis showed that it clustered within viral lineage II. The full genome revealed a 99.2 % identity at the nucleotide level with the full genome of a PPRV isolated in neighbouring Côte d'Ivoire in 2009 indicating a common origin of the viruses.

Enhanced immunosurveillance for animal morbilliviruses using vesicular stomatitis virus (VSV) pseudotypes

N. Logan, W.G. ***Dundon****, A. Diallo, M.D. Baron, M. James Nyarobi, S. Cleaveland, J. Keyyu, R. Fyumagwa, M.J. Hosie, B.J. Willett*

Vaccine. 2016 Nov 11;34(47):5736-5743

The measurement of virus-specific neutralising antibodies represents the "gold-standard" for diagnostic serology. For animal morbilliviruses, such as PPRV or rinderpest virus (RPV), live virus-based neutralisation tests require high-level biocontainment to prevent the accidental escape of the infectious agents. In this paper, the adaptation of a replication-defective vesicular stomatitis virus (VSVΔG) based pseudotyping system for the measurement of neutralising antibodies against animal morbilliviruses was described. By expressing the haemagglutinin (H) and fusion (F) proteins of PPRV on VSVΔG pseudotypes bearing a luciferase marker gene, neutralising antibody titres could be measured rapidly and with high sensitivity. Serological responses against the four distinct lineages of PPRV could be measured simultaneously and cross-neutralising responses against other morbilliviruses compared. It was seen that titres of neutralising antibodies induced by vaccination with live attenuated PPRV were lower than those induced by wild type virus infection and the level of cross-lineage neutralisation varied between vaccinates was observed. By comparing neutralising responses from animals infected with either PPRV or RPV, it was found that responses were highest against the homologous virus, indicating that retrospective analyses of serum samples could be used to confirm the nature of the original pathogen to which an animal had been exposed.

Clade-level spatial modelling of HPAI H5N1 dynamics in the Mekong region reveals new patterns and associations with agro-ecological factors

J. Artois, S.H. Newman, M.S. Dhingra, C. Chaiban, C. Linard, ***G. Cattoli****, I. Monne, A. Fusaro, I. Xenarios, R. Engler, R. Liechti, D. Kuznetsov, T. Long Pham, et al.*

Sci Rep. 2016. DOI: 10.1038/srep30316 1

The highly pathogenic avian influenza (HPAI) H5N1 virus has been circulating in Asia since 2003 and diversified into several genetic lineages, or clades. Although the spatial distribution of its outbreaks was extensively studied, differences in clades were never previously taken into account. We developed models to quantify associations over time and space between different HPAI H5N1 viruses from clade 1, 2.3.4 and 2.3.2 and agro-ecological factors. We found that the distribution of clades in the Mekong region from 2004 to 2013 was strongly regionalised, defining specific epidemiological zones, or epizones. Clade 1 became entrenched in the Mekong Delta and was not supplanted by newer clades, in association with a relatively higher presence of domestic ducks. In contrast, two new clades were introduced (2.3.4 and 2.3.2) in northern Viet Nam and were associated with higher chicken density and more intensive chicken production systems. We suggest that differences in poultry production systems in these different epizones may explain these associations, along with differences in introduction pressure from neighbouring countries. The different distribution patterns found at the clade level would not be otherwise apparent through analysis treating all outbreaks equally, which requires improved linking of disease outbreak records and genetic sequence data.

Genetic Characterization of Circulating African Swine Fever Viruses in Nigeria (2007–2015)

P.D. Luka, ***J.E. Achenbach****, F.N. Mwiine,* ***C.E. Lamien****, D. Shamaki,* ***H. Unger****, J. Erume*

Transbound Emerg Dis. 2016. doi: 10.1111/tbed.12553

Sequencing and analysis of three discrete genome regions of African swine fever viruses (ASFV) from archival

samples collected in 2007–2011 and active and passive surveillance between 2012 and 2015 in Nigeria were carried out. Analysis was conducted by genotyping of three single-copy African swine fever (ASF) genes. The E183L and B646L genes that encode structural proteins p54 and p72, respectively, were utilized to delineate genotypes before intragenotypic resolution by characterization of the tetrameric amino acid repeat region within the hypervariable central variable region of the B602L gene. The results showed no variation in the p72 and p54 gene regions sequenced. Phylogeny of p72 sequences revealed that all the Nigerian isolates belonged to genotype I, while that of the p54 recovered the Ia genotype. Analysis of B602L gene revealed the differences in the number of tetrameric repeats. Four new variants (Tet-15, Tet-17a, Tet-17b and Tet-48) were recovered, while a fifth variant (Tet-20) was the most widely distributed in the country displacing Tet-36 reported previously in 2003–2006. The viruses responsible for ASF outbreaks in Nigeria are from very closely related but mutated variants of the virus that have been circulating since 1997. A practical implication of the genetic variability of the Nigerian viral isolates in this study is the need for continuous sampling and analysis of circulating viruses, which will provide epidemiological information on the evolution of ASFV in the field versus new incursion for informed strategic control of the disease in the country.

BOOK Chapters:

Diagnostics and surveillance methods

E. Spackman, ***G. Cattoli****, D.L. Suarez*

In: Animal Influenza. 2nd ed. p 31-44

High-pathogenicity avian influenza outbreaks since 2008, excluding multi-continental panzootic of H5 Goose/Guangdong-lineage viruses

I. Brown, C. Abolnik, J. Garcia-Garcia, S. McCullough, D.E. Swayne, ***G. Cattoli***

In: Animal Influenza. 2nd ed. p 240-270

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 42 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

Animal Production and Health Newsletter No. 65

The APH Newsletter is prepared twice per year by the Animal Production and Health Section, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and FAO/IAEA Agriculture & Biotechnology Laboratory, Seibersdorf.

International Atomic Energy Agency
Vienna International Centre, PO Box 100, 1400 Vienna, Austria
Printed by the IAEA in Austria, January 2017

17-0028