



Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Animal Production & Health Newsletter



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To Our Readers



Oxen are used for tilling land in many countries (Antananarivo, Madagascar)

Dear colleagues,

It is a pleasure to report back to you on our activities and initiatives since January 2017. Apart from our regular Coordinated Research Project (CRP) activities and the technical support that we give to our national and regional Technical Cooperation (TC) projects, we were also involved in the early and effective diagnoses and control of emerging and re-emerging transboundary animal and zoonotic diseases, such as lumpy skin disease in Eastern Europe and the Balkans, highly pathogenic avian influenza H5N1/H5N8/H7N9 in Western Africa, Europe and Asia, Peste des Petits Ruminants in Asia and Africa, Rift Valley

fever and Ebola in Western Africa and African swine fever in Eastern Europe and Africa. In addition, and in close collaboration with many of you, we were involved in the technical planning of project concepts for new TC projects proposed by Member States for the 2018/2019 biennial project cycle, and in the preparation of the IAEA's and FAO's 2018/2019 work and budget programmes. We hope that these inputs will contribute to serving the best interests of our Member States. Please look at our website or read earlier versions of our Animal Production and Health Newsletter to get fully familiarized with all activities of the Animal Production and Health Section.



A well ventilated, environmentally friendly housing for breeding bulls in BRAC Bull Station, Mymensingh, Bangladesh

In this newsletter issue, I would like to focus on the application of stable isotopes in the field of animal production and health. In animal health, the tracing and monitoring of the movement of animals and their concomitant disease carrying status is of particular importance. For example, viruses of influenza type A can cause infections in multiple animal species, including pigs, horses, poultry and over 100 species of migratory wild waterfowl (WWF), particularly ducks, swans, geese and other wading birds. These viruses can be also transmitted to humans. Migratory WWF have been proven to carry various pathogenic viruses, including viruses of influenza A. Considering the distances they fly between breeding and grounds during their life cycles (often tens of thousands of kilometres), they pose significant risk for long range transmission of diseases. For this reason, understanding the migration pathways of WWF is of critical importance in the estimation of the risk of when and where the disease can be transmitted. A suitable technique is based on the measurement of stable isotope (SI) ratios in tissues of birds, especially in metabolically inert tissues such as feathers. Since the hydrogen isotope composition of environmental water varies spatially across the globe in a predictable manner and its presence is relayed to animal tissues, deuterium (δD) ratio analyses of animal tissues provides a way of linking stable isotope analysis SIA data on water isoscapes with those in biological tissues such as feathers. Certain SIs are involved in important biological and ecological processes and there is a strong correlation between levels of these SIs in the environment and those of the same SIs in avian tissues. Of most interest are deuterium (δD) ratios in tissues that reflect those in surface (lakes, rivers, oceans) and in ground waters. Thus, δD analyses of animal tissues provide a way of linking SIA data on water isoscapes with those in biological tissues such as feathers. These SIA data can successfully reveal migration patterns and enable identification of the breeding areas of birds sampled at non-breeding grounds and disease outbreak sites. In order to improve the resolution of the migration patterns through spatial isoscapes, other isotopes

may be included such as carbon (^{13}C) nitrogen (^{15}N), oxygen (^{17}O or ^{18}O) or sulphur (^{33}S , ^{34}S or ^{36}S). The reference spatial isotopic patterns of the stable isotopes are regularly updated on the Global Network of Isotopes in Precipitation (GNIP) maintained by IAEA. Sampling of WWF is in most cases linked to capturing the targeted birds. Advances in molecular biology (DNA barcoding) enable us to determine the species in biological material collected from the environment. The technique is based on detection of a short gene sequence from a standardized region of the genome used as diagnostic 'biomarker' for species determination. This target sequence is the 648-bp region of the mitochondrial gene, cytochrome C oxidase I (COI), already optimized as a DNA barcode for the identification of animal species, including birds. Combining these three sources of information (bird tracing, virus detection, SI ratios and DNA barcoding) will facilitate the establishment of a platform for the non-invasive monitoring of the risk of spread of avian influenza (and other diseases) through the long range migrations of WWF.

In grazing animals (livestock, wild ruminants and other mammals), plant-wax matters and their compound specific natural ^{13}C concentrations can be used to estimate forage intake, diet composition and to supplement intake. Data on n-alkane profiles and their stable isotope concentrations can be incorporated to develop a practical equation to predict pasture intake of ruminants grazing heterogeneous pastures and rangeland. This data and accordingly adapted practices are to provide tools for better grassland management that enhance animal productivity and reduce impact on environment due to overgrazing, and to allow the design of effective feed supplementation strategies to optimize animal production. Optimization of the utilization of grassland by livestock growers would benefit millions of farmers worldwide since 40 percent of the terrestrial area, excluding Greenland and Antarctica, is covered by grasslands, an important feed source for livestock. In animal nutrition research and feeding practices, several stable isotope and other radio-isotope techniques have definite benefits over conventional techniques: (1) carbon tracers (^{14}C) can be used to develop models for the description of relationships between purine absorption and purine derivative excretion in urine, (2) infusion of ^{14}C labelled acetic and propionic acid are being used to estimate volatile fatty acid production rates, (3) nitrogen (^{15}N) labelled ammonium bicarbonate and ammonium chloride can be used to study microbial degradation of poor quality fibres, microbial mass, utilization of non-protein nitrogen, urea recycling, microbial protein synthesis and amino acid interconversions in rumen, (4) the rate of microbial protein synthesis is determined by phosphorus (^{32}P , ^{33}P), ^{14}N or ^{35}P incorporation in rumen microorganisms, (5) cobalt (^{58}Co), ruthenium (^{104}Ru), chromium (^{51}Cr) labelled forages are used for passage rate determination, and (6) $^{14}C/^{13}C$ labelled sodium bicarbonate infusion techniques are used for estimating carbon dioxide

production in the rumen. Additionally, methane emission by ruminants can be estimated by isotope dilution using either tritium (^3H) or ^{14}C labelled methane.

It is hoped that the tracing, labelling and monitoring stable isotope platforms such as discussed above, stable isotopic platforms will enable us to not only determine the carrier species and their migration patterns, but also serve as a warning system alerting us of animal and zoonotic disease threats. In addition, the application of stable isotopes in animal nutrition provide a basis for improving digestibility, which in turn increases feed conversion rates and energy utilization and reduces GHG emission per unit product.



Livestock is a part of indigenous culture in the Andes Plateau in Peru

Looking back at the activities of the past six months, we had several emergency actions and consultations,

A handwritten signature in black ink, which appears to read 'G.A. Viljoen'.

Gerrit Viljoen,
Head, Animal Production and Health Section

workshops, training courses, research coordination meetings (RCMs) and consultants meetings. Activities scheduled for the next half-year include project review meetings, RCMs, interregional training courses and regional workshops. Both past and future activities are discussed in further detail in this newsletter and are also accessible at our website (<https://www.iaea.org/topics/livestock>). Let us know if you have any ideas, comments, concerns or questions. Please feel free to contact us at any time.

One important point to make is that we plan in future to distribute the APH Newsletter only as an electronic version. To continue receiving this Newsletter, please let us know your email address (to R.Reiter@iaea.org) and also any thoughts you may have on this.

The APH Section wants to welcome Bharani Settypalli and Richard Kangethe as APH staff. Bharani holds an MSc in Biotechnology, a PhD in Molecular Genetics and has 15 years of work experience at national and international levels, both in the private and public sectors. Richard holds an MSc in Biochemistry and a PhD in Molecular Parasitology. He has good experience on irradiated vaccine technologies and animal health, particularly on parasitic diseases. We wish them both a pleasant and productive time with the Section.

I wish you all and your families a great and prosperous rest of 2017.

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The Animal Production and Health Laboratory, Seibersdorf, is an OIE Collaborating Centre for ELISA and molecular technologies in animal disease diagnosis

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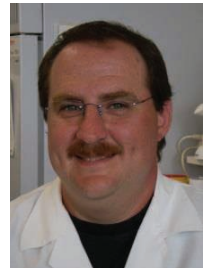
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K. PERIASAMY



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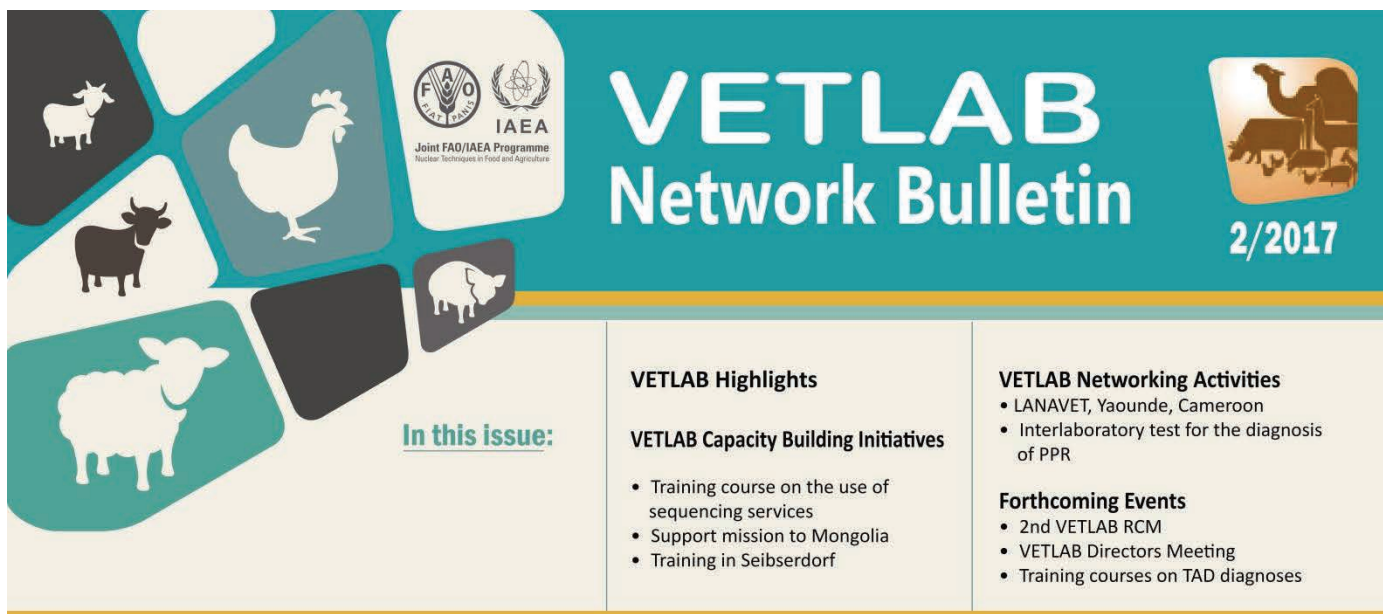
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VETLAB Network Bulletin 2/2017

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To the readers

VETLAB Network

Current membership: 44 countries in Africa and 19 in Asia (June, 2017)

Transboundary animal and zoonotic diseases continue to pose serious threats to animal and human health, in particular, the recent transcontinental spread of avian influenza (AI) H5N8, genetic drift of AI in China during the 5th wave of the H7N9 epidemic and the spread of Pest des Petits Ruminants virus and Lumpy Skin Disease virus to new areas of the globe. Veterinary laboratories are an essential component in the prevention and control of infectious diseases and face the challenge of detecting pathogens as early as possible with the highest possible accuracy.

The transfer of novel technologies through support missions and trainings, the harmonization of laboratory testing procedures through inter-laboratory trials, the supply of standards and reagents to network laboratories are just some of the activities undertaken and promoted by the VETLAB network. Importantly, the global dimension of the VETLAB network facilitates the assistance of national and regional networks in several areas of the world, with the overall aim of synergizing and supporting collaborations between laboratories and increasing their capacities.

Looking forward to meeting you all in forthcoming VETLAB events!

VETLAB Highlights

Highly pathogenic avian influenza (HPAI) H5N8 in Uganda

In January 2017, the HPAI H5N8 virus was reported for the first time in East Africa, along the shores of Lake Victoria in Uganda where mortality was observed in wild birds, domestic ducks and rural chickens. There is no evidence to date of human infections caused by this virus. The National Disease Diagnostics and Epidemiology Centre (NADDEC) in Entebbe is actively involved in HPAI testing of field samples.

H7N9 Asian lineage mutated to highly pathogenic AI virus for poultry

The zoonotic H7N9 avian influenza emerged in China in 2013 as a low pathogenic virus for poultry. Since then, China has experienced five epidemic waves in the human population responsible for 1552 confirmed cases and 596 deaths (June 2017). In February 2017, the occurrence of genetic mutations (genetic drift) in the virus that make it highly pathogenic for poultry was reported. The newly emerged virus maintains dual preference for avian- and human-like receptors.

Interlaboratory trial for Peste des Petit Ruminants virus (PPRV) in 2016

Twenty-seven laboratories representing 24 countries in 3 continents participated in the interlaboratory trial (PPT) exercise in 2016. Sixty-four percent of the laboratories scored 100% for both serological and molecular detection panels. Those that scored 100% for one or all of the panels received a certificate from the Joint FAO/IAEA Division. Additionally, a general country report has been provided addressing different ways to improve PPR diagnosis.

Strengthened Transboundary Animal Disease Control (Livingstone, Zambia; 27 -31 March 2017)

A Coordination Meeting of the AFRA Project RAF5068 brought veterinarians from 17 MMember States together to discuss vector monitoring; Geographic Information System (GIS) based documentation and vector-borne disease diagnostics to support better diagnostics for hemoparasitic diseases. A regional cooperation in poultry vaccine production was requested. The final coordination meeting is foreseen for the end of 2018.



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VETLAB Capacity Building Initiatives

follow up and troubleshoot the implementation of the multiplex testing and the molecular and serological techniques applied for the detection and characterization of the pathogens in small ruminants and swine.

Regional Training Course on the use of Sequencing Services

Thirty five participants from African veterinary and medical laboratories were trained in Morocco on the use of a free-of-charge sequencing services. The course included sample preparation, submission, sequence assembly, sequence alignment, development of phylogenetic trees of animal and zoonotic pathogens, as well as data sharing on recognized genetic databases, such

as GenBank. The service was developed in order to allow counterpart laboratories direct access to sequencing services, as well as contributing to a better understanding of the molecular epidemiology of animal and zoonotic diseases at national, regional and global level.

Training in Seibersdorf

One visiting fellow from the Central Veterinary Laboratory in Harare and one from Botswana National Veterinary Laboratory in Gaborone are currently being trained at the APHL, Seibersdorf, for one month and three months, respectively. The training focuses on rapid laboratory testing for the detection and characterization of pathogens responsible for transboundary animal diseases.

Support mission to Mongolia

A molecular multiplex diagnostic method transferred from the Animal Production and Health Section (APH) to the State Central Veterinary Laboratory enabled the rapid detection of the recent PPRV outbreaks among livestock and wild life populations in the country. An APH expert mission was carried out in May 2017 to

VETLAB Networking Activities

The National Veterinary Laboratory (LANAVET), Yaounde, Cameroon

- It is a public enterprise under the main LANAVET in Garoua. It is technically under the Ministry of Livestock, Fisheries and Animal Industries (MINEPIA).
- The mandate of the laboratory is the diagnosis of animal diseases, the study and surveillance of epizootics, research, quality control of food and food products, and training.
- The laboratory applies serological, molecular and nuclear-related techniques (real-time PCR, conventional PCR, ELISA, LAMP), viral and bacterial isolation and identification, parasite and vector detection and control. It conducts quality control and assurance procedures and it is involved in research and training (e.g. national and international courses, short and long-term fellowships, final year and postgraduate student research supervision).
- The laboratory was created in June 2013. It is principally equipped by IAEA and has strong collaborations with FAO/IAEA, FLI-Germany, DETRA-USA, AU-IBAR, Pasteur Institute in Bangui (Central African Republic), University of Yaounde 1, Predict-Metabiota, Veterinary, Medical and other high schools in Cameroon.
- LANAVET is the only veterinary laboratory in Cameroon and its annex in Yaounde takes care of disease situations in 7 out of 10 regions in the country. The lab is specialized in rapid detection and field diagnosis as it is equipped with a mobile laboratory team. It has a P3-like section for handling high risk bio-hazards. The 2016 HPAI outbreaks in Cameroon was rapidly detected and confirmed by this young laboratory. Several papers are being co-authored with both national and international partners. Inter-laboratory proficiency tests consistently score 100%.
- The laboratory is aiming to efficiently detect and contain new emerging pathogens; to improve capacities on ASFV isolation and production of ASFV reagents; to conduct researches on Rift Valley Fever, Monkeypox, Henipah viruses and other emerging zoonoses; and to organize more national and international training courses on biosecurity and biosafety as well as diagnostic techniques in disease surveillance.

• Interlaboratory test for the diagnosis of PPR

The APH is organizing a PPR proficiency test focusing on its serological and PCR-based detection. Invitations will be sent to laboratories by Summer 2017.



Participants of a laboratory training course at Seibersdorf for members of the VETLAB Network

Forthcoming events

2nd VETLAB Research Coordination Meeting

The meeting will be held from 7-11 August 2017 to discuss the current progress of the project.

VETLAB Directors Meeting

The 2nd joint technical meeting of the VETLAB network, with 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 will take place from 8th to 11th August 2017 in Vienna, Austria.

Two Training Courses on Transboundary Animal Diseases Diagnoses: Early Detection and Characterization

The first course will take place from 25th Sep. to 6th Oct. 2017 at Seibersdorf Laboratories to strengthen veterinary diagnostic and research laboratories capacities for differential diagnosis of infectious animal diseases.

The second course will run from 23rd October to 3rd November 2017 at the National Veterinary Institute (Debre Zeit) in Ethiopia to reinforce knowledge in surveillance and epidemiology on major viral and bacterial pathogens affecting poultry and ruminants.

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Forthcoming Events

Second Research Coordination Meeting on Early Detection of Transboundary Animal Diseases to Facilitate Prevention and Control through a Veterinary Diagnostic Laboratory Network (D3.20.32)

Technical Officers: Ivancho Naletoski, Charles Lamien

The research coordination meeting will take place from 7 to 11 August 2017 in Vienna, Austria.

The purpose of the meeting is to review the current project achievements and fine-tune the future activities of the coordinated research project D3.20.32 'Early detection of transboundary animal diseases (TADs) to facilitate prevention and control through a Veterinary Diagnostic Laboratory Network (VETLAB Network).

Coordination Meeting with Directors of Veterinary Laboratories in Africa and Asia that are supported by ARF and PUI

Technical Officer: Charles Lamien

The coordination meeting will take place from 8 to 11 August 2017 in Vienna, Austria.

This will be the second joint technical meeting of the VETLAB network with 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.

During this meeting, the participants will review their previous achievements, share their experiences and knowledge and formulate work plans for 2018. In addition, through well-structured discussion sessions, they will address their challenges and identify common strategies to better address these issues and strengthen their laboratory capacities to cope with the major transboundary animal (TADs) and zoonotic diseases in Africa and Asia and better contribute to their respective national and regional TADs control strategies.

The meeting will be held in parallel with the second RCM of the VETLAB CRP D3.20.32 to allow interaction between the laboratory directors and the CRP experts and their critical assessment of the CRP progress.

Strengthening Capacities for Surveillance, Data Management and Reporting of Emerging or Re-emerging Zoonotic Diseases (EZDs), including Ebola Virus Disease (RAF0042)

Technical Officers: Ivancho Naletoski, Hermann Unger

The meeting will take place from 21 to 25 August 2017 in Vienna, Austria.

The meeting intends to bring together the main national actors of the networks for communication and early warning system on EZD. They will discuss the infrastructures and procedures in place, examine the gaps and identify the needs to strengthen national and regional capacities for EZD prevention and control.

The meeting participants are expected to bring back to their home country an action plan to strengthen the national strategy and plans on EZD prevention and control (networking, epidemiological surveillance and information sharing) and to implement it.

Consultants Meeting on Nuclear and Nuclear-derived Techniques for Early Pregnancy Diagnosis in Cattle

Technical Officer: Mohammed Shamsuddin

The consultants meeting will take place from 22 to 25 August at the IAEA Headquarters in Vienna, Austria.

The purposes of the meeting are to (1) review and summarize the current state of knowledge on pregnancy related molecules as candidate biomarkers for early pregnancy diagnosis, (2) identify tools and techniques for early pregnancy diagnosis that can be applied along with the artificial insemination field services in developing countries, (3) develop protocols/guidelines to validate/adapt proven techniques for early pregnancy diagnosis under prevailing dairy production systems in the tropics, and (4) identify requirements in terms of equipment, biologicals, isotope labelling of pregnancy associated glycoprotein (PAG), etc., for radioimmunoassay of PAG.

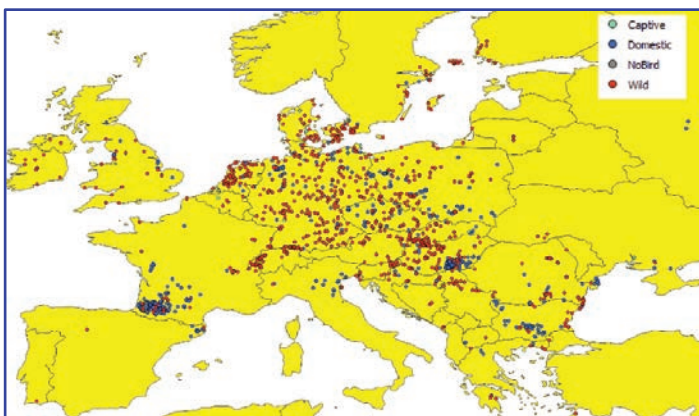
Regional Workshop on the Advanced Techniques for Detection and Differentiation of Avian Influenza Viruses, in the Light of Current Outbreaks of Avian Influenza in Europe (RER9137)

Technical Officers: Giovanni Cattoli, Ivancho Naletoski

The workshop will take place from 11 to 22 September 2017 at Seibersdorf Laboratories, Austria.

In the period from 1 January 2017 until 28 May 2017, Europe was severely affected by avian influenza (AI). According to the FAO EMPRES-i report, total 2187 outbreaks have been confirmed 993 (45%) of which were in wild birds and 1194 (54%) in domestic poultry. Approximately 97% of the outbreaks were caused by the highly pathogenic strains of the AI virus, 94% of all caused by the H5N8 subtype. The disease caused approximately 1 000 000 infections in domestic poultry, affecting 10 000 000 birds (at risk) and resulted in five million dead or destroyed birds. There was a clear link between the detection of the virus in wild birds and the disease outbreaks in domestic poultry.

Many of the Member States' laboratories of the European region have already received support in the use of the classical diagnostic algorithm (M-gene detection, followed by H5 and H7 testing of positive samples and cleavage site sequencing as appropriate for H5 or H7) and have implemented it in their laboratories. However, based on the severity of the current outbreaks and the involvement of wildlife carriers, several Member States have requested support in clarifying the outbreaks and understand the epidemiological role of wild birds in the transmission of the disease.



Confirmed outbreaks of avian influenza in Europe in the period from 1 January 2017 until 28 May 2017 (Source: FAO EMPRES i)

As a response to these demands, IAEA through the Animal Production and Health Subprogramme and the Technical Cooperation Department will organize a training workshop

for the Member States of the European region on avian influenza. The course will cover: i) advanced diagnostics of AI viruses (techniques for screening, confirmation, direct pathotyping, isothermal amplification techniques and use of techniques for differentiation of vaccine from field virus strains); ii) application of diagnostic techniques in surveillance and early detection, including tracing migration of wild birds using stable isotopes; iii) advanced bioinformatics and genetic characterization (conventional vs whole genome and next generation sequencing) and iv) laboratory networking in the support of the surveillance and control programs.

Regional Training Course on Health Management of Small Ruminants, including Parasites Control (RLA5071)

Technical Officers: Mohammed Shamsuddin and Mario Garcia Podesta

The course will take place during 25-28 September 2017 at Facultad de Medicina Veterinaria y Zootecnia, Universidad Cayetano Heredia in Lima, Peru.

The purpose of the course is to enhance knowledge and skills of participants on the health management of sheep and goats involving their major production limiting diseases with special focus on the diagnosis and control of gastrointestinal parasites. The faecal egg count (FEC), estimation of parasitic anaemia, making decision on deworming time and drug choices and risk of drug resistance of parasite will be specifically focused in the course. The course will involve theoretical lectures, practical demonstrations and hands-on sessions on various production limiting diseases of sheep and goats, including parasite infection. The course is open for professionals, filed workers and technicians from the Latin American and Caribbean countries.

Training Course on the Diagnosis of Transboundary Animal Diseases: Multiple Pathogen Detection

Technical Officer: Charles Lamien

The training course will take place from 25 September to 6 October 2017 at Seibersdorf Laboratories, Austria.

The purpose of this training is to strengthen the Member States veterinary diagnostic and research laboratories capacities for differential diagnosis of infectious animal diseases. Using multi-parametric technologies can facilitate the detection and differentiation of pathogens causing infectious diseases with similar clinical signs in a single reaction vessel. The training will consist of lectures on the principles and practical sessions on the applications

of multi-parametric technologies for the diagnosis of the major transboundary and zoonotic animal diseases threatening the livelihood and the health of the population in several Member States in Africa and Asia. This training is open to selected African and Asian Member States.

Training Course on the Diagnosis of Transboundary Animal Diseases: Early Detection and Characterizations

Technical Officer: Charles Lamien

The training course will take place from 23 October to 3 November 2017 in Ethiopia.

The purpose of this training is to promote the application of accurate and differential diagnosis of major transboundary and zoonotic animal diseases in the veterinary laboratories of the Member States. This training will reinforce the participants' knowledge to detect, conduct surveillance of, and perform epidemiological studies on the major viral and bacterial pathogens affecting poultry and ruminants.

It will consist of lectures and practical sessions on applications of molecular and serological diagnostics, differential diagnostics and molecular epidemiology for highly pathogenic influenza viruses, Newcastle disease virus, infectious bursal disease virus in poultry and Rift Valley fever, *Brucella abortus* and pox diseases in ruminants and camels. The course is open to scientists from sub-Saharan African veterinary diagnostic laboratories members of the VETLAB Network and supported by the IAEA Peaceful Uses Initiative (PUI) and African Renaissance Fund (ARF) projects.

Regional Training Course on Assisted Reproductive Techniques in Sheep and Goats (RLA5071)

Technical Officer: Mohammed Shamsuddin

The course will take place during the fourth quarter of 2017 in Argentina.

The purpose of the course is to increase participants skills for the conduction of routine artificial inseminations (AI) in sheep and goats involving ram and buck selection and management, semen collection, evaluation and preservation, oestrus synchronization and insemination, both transvaginal and laparoscopic, and pregnancy diagnosis. The course will involve theoretical lectures, practical demonstrations and hands-on sessions on various assisted reproductive techniques including AI and embryo transfer in sheep and goats. The course is open for

professionals, field workers and technicians from the Latin American and Caribbean countries.

2017 Peste des Petits Ruminants (PPR) Proficiency Test

The PPR proficiency test is an extremely valuable exercise for Member State laboratories to evaluate their capacity to diagnose PPR, a very severe disease affecting small ruminants in many areas of the world. Like in previous years, APHL is organizing a PPR proficiency test focusing on serological and PCR-based detection. Invitations will be sent to laboratories by summer 2017. The entire exercise will conclude by the end of the year with a confidential evaluation of the results and recommendations to improve detection.

Past Events

International Conference on Non Tsetse Transmitted Animal Trypanosomosis

The conference was held in ANSES, Paris, France, from 14 to 16 December 2016.

The first International Conference on Non Tsetse Transmitted Animal Trypanosomosis (NTTAT) was held at the French Agency for Food, Environmental and Occupational Health & Safety in Paris, France, with the coordination of the OIE NTTAT Network. Participants drawn from 32 countries representing various backgrounds including NTTAT endemic countries from Africa and Asia, research counterparts from Europe, OIE, and members of the global veterinary pharmaceutical industry attended the conference. APHL was able to present during the vaccination session on the use of irradiation as a tool for developing a vaccine against *T. evansi*. No vaccine against *T. evansi* and other NTTATs exists and few effective drugs are available. Evidence on efficacy of current drugs to cure the neurological stages of NTTAT infections is conflicting while evidence of drug resistance continues to grow. The work at APHL has shown that exposing *T. evansi* parasites to low doses of irradiation leads to an infection that is less virulent when compared to infections initiated with non-irradiated parasites. This work has led to the identification of genes that are likely to be involved in virulence and are important for establishing disease in the mammalian host. Exploiting this panel of genes would assist in developing vaccines and new drug targets especially in cases where increasing drug resistant infections have been identified.

The conference presented a good platform where we could present our efforts at APHL involving the use of

irradiation as a tool for vaccine development in *Trypanosoma* spp. due to the attendance of participants from various backgrounds. The feedback from participants created new opportunities for the laboratory to collaborate in different areas with other centres of research. Contact with the different parties of interest was initiated and collaborations will be developed in future work plans.



Participants from the first International Conference on Non Tsetse Transmitted Animal Trypanosomosis

Workshop on Flow Cytometry for Veterinarians in Sudan (SUD5036)

Technical Officers: Viskam Wijewardana and Giovanni Cattoli

In the framework of TC project SUD5036, a workshop on flow cytometry was conducted in Khartoum, Sudan on 14 and 15 December 2016, organized by APHL in collaboration with the Animal Resources Research Corporation of Sudan. Nineteen scientists from the Veterinary Research Institute, Central Laboratory of the Ministry of Higher Education and Scientific Research and Faculty of Medical Laboratory Sciences, University of Khartoum, took part in this training workshop. The objective of the workshop was to train scientists on the use of flow cytometers to measure vaccine responses. The Animal Resources Research Corporation of Sudan is planning to acquire a flow cytometer and therefore the training of these scientists will facilitate the start of evaluation of vaccines using flow cytometry.

National Training Course on the Delivering of Dairy Cattle Reproduction Enhancement Services On-farm (ELS5012)

Technical Officer: Mohammed Shamduddin

The training course took place from 23 to 27 January 2017 at the University of El Salvador, San Salvador. The course was organized by the Department of Animal Science,



Lecturer briefs participants before starting hands-on sessions on the enhancement of dairy cattle reproduction

Faculty of Agronomy Sciences, University of El Salvador (UES) with Mr Ludwing V. Leyton Barrientos as the Course Director. The IAEA appointed an external lecturer, Dr Carlos Lamothe Zavaleta from Universidad

The objectives of the course were to provide on-site hands-on, training to professionals and academic staff on reproduction management in dairy cattle involving (1) examination of cows and heifers for the diagnosis and treatment of gynaecological disorders, (2) evaluation and improvement of herd fertility, (3) organization of artificial insemination (AI) services, (4) pregnancy diagnosis and



Ultrasonography for pregnancy diagnosis in a cow

the monitoring of AI service quality and (5) monitoring of postpartum reproduction and making breeding decisions to maximize production in dairy farms.

Sixteen participants, including UES staff, students, veterinarians and animal science professionals attended the training. Theoretical lectures, practical demonstrations and hands-on sessions were conducted at the UES Experimental Station. The lectures included a review of anatomy of the reproductive organs, oestrous cycle and its hormonal regulations, puberty and postpartum reproduction, genital examination by rectal palpation, principles of ultrasonography, induction to ovarian activity, interaction of nutrition and reproduction, oestrus synchronization, main causes of abortion, bull examination and interpretation of bull semen catalogues. Practicals included demonstrations and hands-on sessions of per-rectal examination of female reproductive organs, diagnosis of reproductive disorders, and application of ultrasonography for the diagnosis of early pregnancy and reproductive disorders.

The course participants appreciated the course content and delivering skills of the lecturer.

First Research Coordination Meeting on the Quantification of Intake and Diet Selection of Ruminants Grazing Heterogeneous Pasture Using Compound Specific Stable Isotopes (D3.10.29)

Technical Officers: Mohammed Shamduddin, Mario Garcia Podesta

The first research coordination meeting (RCM) of CRP D3.10.29 was held from 23 to 27 January 2017 at the Vienna International Centre, Vienna, Austria.

The objectives of the meeting were to (1) enable individual Research Contract (RCs) holders to share their national data on pasture and grassland-based cattle production systems, (2) share the state of the art on the stable isotope and NIRS technologies for estimating intake and diet compositions by Research Agreement (RA) holders, (3) discuss and agree with project objectives, methodologies and work-plans and identify needs for protocols, standard operating procedures (SOPs) and guidelines, (4) discuss and finalize work plans of individual research contracts, (5) conduct a workshop on sampling plants, diets and faeces and animal feeding experiments, leading to the development of the CRP general protocol and (6) identify a way forward to increase connectivity and training and additional funding opportunities.

Individual RCHs presented their country data, project objectives and work-plans. Except Argentina, all RCHs will harvest grasses from natural pastures, individually identify four major grass species and a fifth group with remaining minor species, collect samples from identified

plant species and mix plants to a diet. Argentina will individually culture *Avena sativa*, *Hordeum vulgare*, *Vicia* spp and include *Eragrostis curvula*, panicum and alfalfa from pre-existing paddocks, collect plant samples and mix them to a diet. Brazil will use grasses from the silvopastoral cattle system and include *Echinolaena inflexa*, *Brachiaria decumbens*, *Brachiaria brizantha*, *Tithonia diversifolia* and a most representative shrub. China-20769 will use both grass dominant and sedge dominant pastures. China-20874 will include xeric grasses. Chile will include six grass species vis., *Lolium perenne*, *Bromus stamineus*, *Dactylis glomerata*, *Trifolium repens*, *Holcus lanatus*, *Agrostis capillaris*, the fifth and the sixth will be classified as minor species. Ethiopia plans to conduct a survey and identify four major and one minor plant species in a natural grass land. Madagascar will include a mixed pasture involving four species plus *Brachiaria* spp. during the wet season and *Lolium multiflorum* during the dry season. Uganda will include five grasses from amongst *Brachiaria decumbens*, *Hyparrhenia filipendula*, *H. rufa*, *Sporobolus pyramidalis*, *Cymbopogony nardus*, *Loudetia kagerensis*, *Panicum maximum*, *Themeda triandra* and *Chloris gayana*. China-20769 will include yak for the animal experiment and all other RCHs will use cattle. Brazil will do total faeces collection and all other RCHs will do spot faeces collection per rectum.



Participants of the RCM meeting

Individual RA holders presented the current state of knowledge on the topic. The workshop was dedicated to develop a detailed protocol for the conduction of the field and laboratory activities. The meeting also consisted of individual consultation sessions between individual RC holders, RA holders and FAO/IAEA staff.

The meeting agreed that the CRP was timely and its successful completion and adoption of results will allow participating RC holders to develop a pasture based cattle production system with the optimization of supplementations where necessary and thus maximizing production and preventing pasture degradations. The work plan proposed in the CRP was discussed and partially modified to accommodate challenges in individual conditions.

During the first phase of the CRP, a minimum of eight mature cattle/yaks will be penned and fed with a known

set of five pasture/browse fresh grasses. Half of the animals will receive 10% extra of maintenance levels and the other half will be fed *ad libitum*. During the enclosure, feed composition and feed intake will be recorded, n-alkane will be orally administered, and feeds and faecal samples will be collected. This procedure will be conducted in two major seasons over an 18 months period.

Conventional wet chemistry analysis, alkane profiles and stable carbon isotope composition (Carbon-13) of n-alkanes are expected to provide reliable data related to the nutritional value of feeds, dry matter intake and plant proportions. These data in conjunction with near infrared reflectance spectroscopy (NIRS) will allow the development of prediction equations of dry matter intake. The equations would help better management of farms under grazing conditions for improving animal productivity.

A global coding system will be implemented for labelling the samples and template sheets for data input will be designed and shared. RC holders will report progress done based on these work plans in the 2nd RCM by the first quarter of 2019. Based on results obtained, additional research activities will be developed and agreed during the 2nd RCM to field test the predicted equations under grazing conditions.

Training and technical support were recommended for building human capacities on NIRS, alkane and isotope data interpretation during the second RCM.

National Training Course on Animal Identification, Recording Phenotypes and Performance Data to Enhance Cattle Breeding in Madagascar (MAG5024)

Technical Officer: Mohammed Shamsuddin

The training course took place from 20 to 24 February 2017 at the Centre National de la Recherche Appliquée au Développement Rural (FOFIFA), Antananarivo, Madagascar.

The course was organized by the Département de Recherches Zootechniques, Vétérinaires et Piscicoles with Mr Norbertin Ralambomanana as the Course Director. The IAEA appointed an external lecturer, Mr Filippo Biscarini, Lodi, Italy.

The objectives of the course were to provide on-site hands-on, training to professionals, technicians and livestock field workers on animal identification, recording phenotypes and performance data, setting a recording system for pedigree and progeny performance data, continually acquiring phenotypes for the target population and data management and statistical analysis. Eighteen

participants from FOFIFA and the Livestock Department participated in the training.

Theoretical lectures and practical demonstrations and hands-on sessions were conducted on the importance and benefits of animal identification, methods available to uniquely identify individual animals with special emphasis given to radio-frequency identification systems (RFID), on-farm data capturing, storing and management and use of the statistical software R for the analysis of data. Directeur General de l'Institut National des Sciences et Techniques Nucleaire and senior staff from FOFIFA were present at the closing ceremony of the training.



Hands-on training

The training objectives were met and were considered by all participants to be very successful. The participants learnt how to apply RFID electronic identification to local cattle, how to record animal identity and associated phenotypes, and how to transfer data to their computers for further analysis. The participants learned how to use the R environment for data manipulation, description, visualization and statistical analysis. The participants were also given a general overview of the use of animal identification, phenotype recording, data analysis for cattle breeding and selection programmes.

Meeting of the OIE/FAO Network of Expertise on Animal Influenza, Italy

Due to the continuous threat posed by avian influenza to animal and public health in several Member States, this disease has high priority within the APH Subprogramme. APHS staff is actively involved in the OIE/FAO Network of expertise on animal influenza (OFFLU) and participates in the regular meetings of the Executive and Steering Committee.

OFFLU is working to reduce the negative impacts of animal influenza viruses by promoting effective collaboration between animal health experts and with the human health sector (www.offlu.net). The last OFFLU meeting was held in the FAO Headquarter in Rome, Italy, 29 to 31 March 2017.

The purpose of the meeting was to discuss and update actions and activities with regard to the avian influenza epidemics (H5N1/H5N8/H7N9) world-wide. Other objectives of the meeting were to engage participating laboratories, share virus characterization data, agree on a methodological approach for data compilation and analysis and to progress matters to ensure diagnostic test

harmonization and to agree the delivery of proficiency test among the Reference Centres designated by FAO and OIE.

Mid-term Coordination Meetings for AFRA project 'Improving Livestock Productivity through Strengthened Transboundary Animal Disease Control using Nuclear Technologies to Promote Food Security (AFRA)' (RAF/5/068)

Technical Officer: Hermann Unger

The meeting took place from 27 to 31 March 2017 in Livingstone, Zambia.

The project focuses on two limiting factors in livestock production, vector borne disease management and delivery of support services for small scale commercial livestock farmers. The objective of this meeting was to review the progress made and results achieved in each participating country, highlighting bottlenecks and lessons learnt from the implementation of the project activities; and to plan further activities. Participants from 17 Member States contributed with presentations and in open discussions on these topics. The Vector Borne Diseases (VBD) complex was seen as the most important impediment of livestock production in Africa. Lack of entomological knowledge, surveillance and tools supporting risk models are the biggest hurdles. Field diagnostics tools are missing as well as vaccines against most of these haemoparasites.

The impact of the training course, specifically in diagnostics of VBD, was very much appreciated and further research into better diagnostic tools for haemoparasitic diseases was requested. New focuses should be on poultry diseases such as avian influenza and Newcastle disease which are continuously posing a big risk to production and food security. A common training course on the production of Newcastle disease vaccine was encouraged if additional funding could be sourced.

Expert Meeting to Fine Tune RTC on Bat Collection for EVD Diagnostic in Wildlife (RAF0042)

Technical Officers: Hermann Unger

The expert meeting took place from 24 to 27 April 2017 in Freetown, Sierra Leone.

One of the objectives in the emerging zoonotic diseases project is the monitoring of wildlife and their role in maintaining or spreading infectious agents. Bats are very peculiar species of mammals in terms of their immune system and they can be good indicators for some of

Emerging Zoonotic Diseases (EVD). As Sierra Leone has an ongoing bat surveillance programme based at Njala University, Mr Warnau, Section Head, TC Africa 3, and Mr Unger visited the university to arrange the implementation of regional training courses in wildlife sampling with a focus on bats. Discussions with Dr Lebbie and Dr Suluku about their ongoing work on bats and molecular disease diagnosis and visits to the local facilities allowed the defining of goals and modalities for the training courses. As a high number of bats are present at the Njala University campus, the training on bats capture can be accomplished there. A preliminary course plan was developed and the needs defined. The first training course will be held at the end of November 2017, as the local bat population is rather stationary at that period of the year. The course dates will be announced once decided.

First Research Coordination Meeting on the Irradiation of Transboundary Animal Disease Pathogens as Vaccines and Immunity Inducers (D3.20.33)

Technical Officers: Hermann Unger, Viskam Wijewardana

The research coordination meeting (RCM) took place from 3 to 7 April 2017 in Vienna, Austria.



RCM participants and staff

Six contract holders and one consultant attended the RCM. The objectives of the meeting were to share and discuss the experiences of the participants on producing irradiated vaccines, to discuss individual research activities and work plans of the research contract holders. The research agreement holder, Dr Sebastian Ulbert of Fraunhofer Institute for Cell Therapy and Immunology, Germany, gave valuable inputs on the use of a novel method for the inactivation of pathogens with low energy electron irradiation and process development. This method can be used to deliver a higher dose of irradiation within a very short time compared to traditional gamma sources. There was a rich exchange of information on previous experiments, where one participant presented developing irradiated vaccines to viruses (white spot syndrome and

foot and mouth disease) and two participants - on bacteria (*Mannheimia* and *Brucella*) and two more participants - on parasites (*Haemonchus* and *Fasciola*). Although good protection has been achieved with some of these vaccines, most need optimization specifically for enlarging the production. When irradiating to produce metabolically active but non-replicative antigens safety issues will be very important. The evaluation of vaccine safety and efficacy through animal experiments was discussed in length as well as surrogate parameters to abolish challenge studies. Immunological assays to evaluate vaccines, especially on cell mediated immunity, could be a good solution and APH will support the different research activities as they have already developed a number of immunological assays and will be specifically looking at cytokine response assays next. Participants were also informed on aspects of vaccine preservation and formulation. It was agreed that research contract holders would achieve the optimum doses to irradiate pathogens and begin producing vaccine doses after safety analysis prior to the next RCM.

Consultants Meeting on Advanced Diagnostic Technologies for Detection and Differentiation of Animal and Zoonotic Diseases

Technical Officer: Ivancho Naletoski

The consultants meeting took place from 10 to 12 April 2017 in Vienna, Austria.

Five invited experts from advanced laboratories presented their work on the current developments in diagnostic technologies, as follows: i) Dr Ian W. Lipkin from the Center for Infection and Immunity, Mailman School of Public Health, College of Physicians & Surgeons, Columbia University, New York, USA; ii) Dr Jianning Wang from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia; iii) Dr Quan Wang from the Shanghai Veterinary Research Institute, Chinese Academy of Agricultural Sciences, China; iv) Dr Venkatakrishnan Venkataraman, Indian Institute of Science, Bangalore, Karnataka, India; and v) Dr Lidewij Wiersma from the FAO Headquarters in Rome.

The focus of the experts' presentations was high throughput platforms for molecular and serological diagnosis, surveillance and discovery, the use of advanced diagnostic technologies and next generation sequencing in the discovery of novel infectious agents, nanoparticle-based methods for the rapid and ultrasensitive detection of pathogens and drug residues and low cost microchip PCR and room temperature stable membrane ELISA platform for point-of-care human and veterinary medical diagnostics.

Fifteen additional participants attended the meeting, some of them also presented their work on the application of advanced diagnostic technologies in surveillance, control and eradication of animal and zoonotic diseases, such as the development of point-of-care diagnostics for contagious bovine and contagious caprine pleuropneumonia (Dr Joerg Jores, Institute of Veterinary Bacteriology, Bern, Switzerland); the use of whole genome sequencing and multiple locus variable-number tandem repeat analysis in the understanding of the epidemiology of brucellosis (Dr Giuliano Garofalo, Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise "G. Caporale", Teramo, Italy); practical applications of the multiple locus variable-number tandem repeat analysis in the control of brucellosis in vaccinated and non-vaccinated populations (Dr Igor Dzadzovski, Faculty of Veterinary Medicine, Skopje, The FYR of Macedonia) and the use of thermo-stable, single-domain antibody (nanobody technology) in disease diagnosis (Dr Emmanuel Tumininu Obishakin, National Veterinary Research Institute - NVRI, Nigeria).

At the end of the meeting, extensive discussions were held with the experts and the participants, mainly on three topics: i) selection of diagnostic technologies ready for integration and dissemination under the APH subprogramme, ii) selection of suitable laboratories (laboratory infrastructures) ready to implement such technologies, and iii) definitions of the scopes of use of such technologies in the control and eradication of animal and zoonotic diseases in Member State laboratories.

National Training Course on Biosecurity for Field and Laboratory Teams in Charge of EIDs (RAF0042)

Technical Officer: Hermann Unger

The National Training Course took place in Cameroon Yaounde from 24 to 28 April 2017.



Mr Abel Wade, course Director, and participants

Thirty two participants from human health, animal health, wildlife and environmental institutions of both the public and private sectors received theory and practical training

in biosecurity and biosafety during emerging infectious disease investigations. The training also covered surveillance activities from how to detect a case in the field, sample collection, packaging and shipment to a diagnostic laboratory, and how to handle a potential infectious sample in the laboratory in order to generate credible results with minimal risk of contamination.

The risk of being infected and how an infectious pathogen spreads was discussed and participants were also trained on risk and risk analysis (risk detection, evaluation, assessment, classification and management) in the field. Practical demonstrations with relevant scenarios were also included. At the end of the training, each participant was given a certificate from the Ministry and some Personal Protective Equipment (PPE) for immediate use.

Regional Training Course on the Nuclear and Nuclear Related Techniques for Early and Rapid Detection and Differentiation of the Middle East Respiratory Syndrome in Camels (RAS/0/073)

Technical Officers: Ivancho Naletoski, William Dundon

The course was held at the APH Laboratory in Seibersdorf from 24 April to 5 May 2017.

The Middle East Respiratory Syndrome (MERS) is an infectious respiratory disease of humans caused by a coronavirus (CoV). According to the World Health Organization (WHO), from September 2012 (discovery of the MERS CoV), until the end of 2016, 1952 cases with 693 deaths have been reported from 27 countries. The disease is present primarily in the region of the Middle East, especially in the Arabian Peninsula. Dromedary camels have been shown to be reservoirs of the virus either indirectly (transmission of virus to patients close contact with camels) or directly through isolation, molecular detection and/or serological evidence. There are indications that other animals may play a role in disease transmission (e.g. sheep and bats), but their epidemiological importance is still to be clarified.

Upon request of the veterinary authorities of Member States from the Middle East region, the IAEA, through the APH Subprogramme and IAEA Technical Department organized a training course on the nuclear and nuclear related techniques for the early and rapid detection and differentiation of the MERS CoV infections in camels.

Nineteen participants from seven Member States attended the meeting. The course was supported by five invited international experts.

Topics of the training course covered the epidemiology of the disease (review of both, human and animal infections),

techniques used for detection of specific antibodies against MERS CoV in camels - ELISA technique targeting antibodies against the S1 antigen of the MERS CoV, as well as molecular techniques used for detection of the viral RNA - Real-Time RT-PCR targeting the ORF1 a gene of the virus, and two additional conventional RT-PCRs used for confirmation and sequence analysis targeting the RNA-dependent RNA polymerase (RdRp) and nucleocapsid (N) protein genes. The participants also received practical training on basic bio-informatics and epidemiological considerations for the use of the assays in the field.



Participants at the Regional Training Course on the Nuclear and Nuclear Related Techniques for Early and Rapid Detection and Differentiation of the Middle East Respiratory Syndrome

Regional Training Course on the Use of the IAEA Genetic Sequencing Services for Member States (RAF0042)

Technical Officers: Ivancho Naletoski, Hermann Unger

The training course took place from 2 to 12 May 2017 in Rabat, Morocco.

The dynamics of diseases spread, as well as the number of pathogens arising as priorities (especially among zoonotic diseases) require more and more sophisticated tools for differentiation of animal and zoonotic pathogens for a deeper understanding of disease epidemiology, to prevent or minimize future spreads, and eventually predict future patterns of the disease outbreaks. One of the most commonly used tools is the sequencing of targeted genetic fragments of the pathogen in order to enable sequence alignment and comparison as well as the generation of phylogenetic trees. For many pathogens of animal health and zoonotic importance there are already established targets for such analyses (for example E2 and 5NTR region of the CSF virus, VP1 region for FMD, p72/p54 for ASF and the cleavage site for AIV), as well as global databases for sequence sharing and comparison, such as the NCBI-Genbank. However, there are still obstacles for wider dissemination of this technology in the Member State laboratories, such as the costs of the hardware, cost

of individual runs, trained personal and the required number of samples to clarify an outbreak.

To overcome these problems, at the end of 2015 APH has established a procedure which enables Member States laboratories permanent access to sequencing services through an approved subcontractor engaged by IAEA. The cost of the service is covered by IAEA and is fully free of charge for the counterpart laboratories, including shipment. The process is supported by a set of standardized instructions aimed at guiding the users through the whole workflow starting from sample preparation (amplification and quality control), sample submission and shipment, sequence assembly, alignment and analysis, as well as publishing in open-access databases. As of the beginning of May 2017, thirty six laboratories have registered to use the service and approximately 500 samples have been submitted for sequencing.

The regional TC projects RAF/0/042 and RAF/5/073 are aimed at the capacity building of techniques for early detection and differentiation of emerging and re-emerging zoonotic diseases, including ebola virus disease, in a one-health setting (i.e. veterinary and medical authorities working together). So far, several regional training courses on biosecurity in the field and early detection of priority pathogens have been organized and the relevant detection techniques transferred into the designated laboratories of the Member States. However, few of these laboratories have access to sequencing services. The purpose of the training course was to offer the participants practical exercises on the whole process and to disseminate it into the designated national laboratories. At the end of the course, participants have expressed great interest on the topic: 22 of them registered to use the service during the training course, the rest are expected to register in the near future.

The training course was held in Casablanca, Morocco, hosted by the National Food Safety Office (ONSSA), Veterinary Directorate of Morocco. Forty participants from 28 African Member States attended the course under the guidance of two expert lecturers.



Participants at the Regional Training Course on the Use of the IAEA Genetic Sequencing Services for Member States

National Training Course on Enhancing the Proficiency of the Semen Lab for Routine Freezing of Bull Semen (MAU5004)

Technical Officer: Mohammed Shamsuddin

The training course took place from 15 to 19 May 2017 in Nouakchot, Mauritania. The course was organized by the National Office for Research and Development of Livestock (ONARDEL), Ministry of Livestock in Mauritania with Dr Baba Doumbia as the Course Director.

The IAEA appointed an external lecturer, Mr Naceur Ben Mekki from Tunisia.



A participant practices semen collection from a bull

The objectives of the course were to further increase the skills of ONARDEL's staff in bull semen collection and preservation and to set protocols and guidelines for routine freezing of bull semen with assured quality, specifically on (1) management of bulls and teaser before, during and after semen collection, (2) evaluation of semen for sperm motility and concentration, (3) dilution, (4) straw printing, (5) straw filling and sealing, (6) freezing and examination of sperm motility after thawing. The importance and procedures of quality control in the semen lab and welfare issues related to bulls was also explained.

Seven participants, all ONARDEL staff, attended the training. Theoretical lectures, demonstrations and practical exercises were carried out in the laboratory and at the bull rearing facilities. The exercises also included operation and calibration of laboratory equipment and routine laboratory procedures for semen evaluation, dilution preservation and storage.

Lectures, focus discussions and demonstration were conducted on the selection of bulls and their welfare, feeding, semen collection and routine health management. The importance of keeping proper records on animals, laboratory equipment and semen was discussed.

Regional Training Course on the Use of Decision Making Tools for Remediation Measures in Animal Production Systems (RER9137)

Technical Officer: Ivancho Naletoski

The training course took place from 22 to 25 May in Budapest, Hungary.

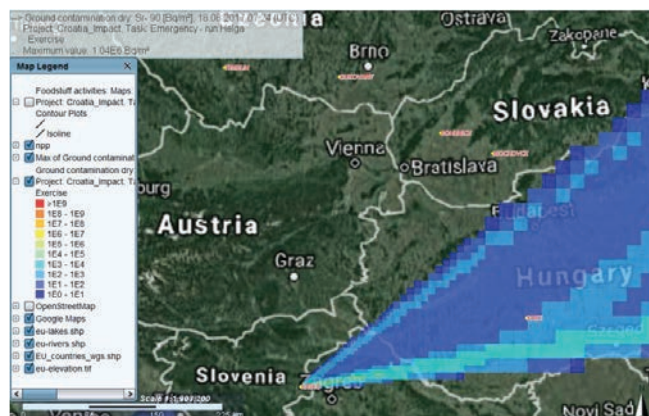
The aim of the project RER9137 is to strengthen the preparedness of veterinary authorities in the European region in responses to nuclear and radiological emergencies affecting animal production systems to prevent entry of contaminated animal products into the food chain. The activities of the project are structured in a way to enable integration of the IAEA response standards into the existing emergency plans of participating Member States, to upgrade the current understanding of the official veterinarians in the risks related to radiological contamination of animals and animal products, as well as to implement standardized remediation measures covering the whole animal production systems.

Mitigation measures (management options) for animal production systems are the key actions necessary to control contamination before, during and after nuclear and radiological emergencies. They have been extensively elaborated through the European Framework Programme 6 project – EURANOS and updated with the UK Recovery Handbooks for Radiation Incidents of Public Health England. Based on these two products, a standardized decision-making process for selection of mitigation measures (management options) has been developed, in the form of a decision making questionnaire, which enables selection of the most appropriate management options for any specific situation and environment.

In order to upgrade the capacity of veterinary authorities in the development and implementation of specific and efficient management options, a regional training course was organized. Twenty four participants from 20 countries of the TC European region attended the course. With the support of three invited international experts, the training course was designed to deliver theoretical and practical knowledge in remediation management options, applicable for the whole animal production chain, including animal facilities, live productive animals and animal products.

The course was comprised of presentations on the impact of the remediation measures during several nuclear emergencies from the past (Kyshtym, Windscale, Chernobyl and Fukushima), as well as practical exercises on the development of remediation strategies for animal production systems using simulation exercises. Five virtual scenarios on nuclear accidents were developed by the experts and given to the participants of the five working groups: i) Kozloduy, Bulgaria with release of 137Cs

affecting beef cattle, ii) Ignalina, Lithuania, with release of 131I affecting dairy and iii) beef cattle, iv) Krško, Slovenia with release of 131I, 137Cs and 90Sr affecting beef production and v) Metsamor, Armenia with release of 137Cs and 90Sr and affecting both, meat and milk production. The participants were expected to analyse the pre-designed scenarios and develop a remediation strategy through a set of management options which would lead to mitigation of the consequences of the virtual nuclear accidents and prevent entry of contaminated products into the market at the early phase of production (e.g. slaughterhouses, milk collection stations or pre-processing plants).



Detail from the simulation exercise (scenario) during the training course. Virtual nuclear accident in Krško, Slovenia with the distribution of 90Sr (Bq/m²)

The procedure for the development of the mitigation strategies was based on the already developed and standardized decision-making tree, adapted for implementation in the animal production systems and included the necessary communications channels for notification the national nuclear safety authorities.

The potential impact of the implemented strategies was also discussed between the groups with support from the invited experts.



Participants at the Regional Training Course on the Use of Decision Making Tools for Remediation Measures in Animal Production Systems

National Training Course on Improving Skills on the Use of Hormone Radioimmunoassay at Artificial Insemination in Cattle (URT5031)

Technical Officer: Mohammed Shamsuddin

The training course took place from 22 to 26 May 2017 at the Vector and Vector Borne Diseases Research Institute (VVBDR) in Majani Mapana, Tanga, United Republic of Tanzania.

The course was organized by the Vector & Vector Borne Diseases Research Institute with Dr Oliva Manangwa as the Course Director. Dr Geoffrey Mbata from VVBDR acted as the focal point and was responsible for organising the course. The IAEA appointed an external lecturer, Mr M. Mutasem Khadra from Vienna, Austria.



Participants of the training course

The objective of the course was to increase knowledge and skills, enabling participating professionals use progesterone radioimmunoassay for quality assurance of artificial insemination (AI) services. In addition, the production and use of milk and plasma standards and Internal Quality Control (IQC) samples for radioimmunoassay (RIA) of progesterone was discussed and demonstrated.

Twenty professionals and technicians from Tanga and nearby districts and provinces participated in the course. Theoretical lectures included the overall description of RIA with emphasis on progesterone RIA, the handling of RIA kits, the progesterone RIA protocol, use and care of micropipettes, and preparation of milk and plasma standards as well as internal quality control (IQC) samples. All lectures were translated into Swahili by Dr Geoffrey Mbata to facilitate understanding for participants.

Practical sessions including demonstrations and hands-on exercises were carried out on accuracy and skill of pipetting by individual participants, and on preparation of charcoal-stripped plasma and milk where progesterone and

other hormones were removed. The progesterone-free plasma and milk samples were used in the preparation of standards and IQC samples. Step by step pipetting of standards, IQC samples, test samples, antibodies and iodine-125 labelled tracers and the measurement of radioactivity and calculation of progesterone values using standard curve were discussed and demonstrated.

Regional Training Course on Genetics of Parasite Resistance in Sheep and Goats: Animal Breeding and Selection Practices (RLA5071)

Technical Officer: Mohammed Shamsuddin

The training course took place from 5 to 9 June 2017 at San Carlos de Bariloche, Rio Negro, Argentina.

The course was organized by the Instituto Nacional de Tecnología Agropecuaria at the Experimental Station in San Carlos de Bariloche, Rio Negro, Argentina with Dr Mario A. Poli as the Course Director and Dr H. Taddeo as a local coordinator. The IAEA appointed an external lecturer, Dr Yuri Tani Utsunomiya, Universidade Estadual Paulista, Aracatuba, Brazil.



Participants of the course

Objectives of the course were to (1) improve skills in applying selection theory and models to sheep breeding, (2) improve human capacity to design animal selection schemes and define selection objectives and to conduct statistical analysis of data for the selection of breeding stocks, and (3) to provide participants with a better understanding of the potentials and perspectives of using genomics tools in breeding sheep and goats.

Twenty two professionals, involving animal scientists and veterinarians, from 12 countries participated in the training. Three local lecturers and one from Brazil acted as instructors during the training.

Lectures and focus discussions involved (1) tools for measuring the impact of breeding programmes using phenotypic data, (2) estimation of breeding values using quantitative models, (3) building index selection with the combination of appropriate parameters, (4) introduction to DNA technologies, molecular markers, SNPs chip and

sequencing analysis, (5) basics in SNPs chip data entry, data quality control and analysis including software used for statistical analysis, (6) estimation of conventional and genomic breeding values.



Participants attend practical demonstration on the evaluation of fibre quality for genetic selection of sheep

Practical demonstrations and hands-on sessions were conducted on (1) the management of large datasets, (2) strategies to monitor genetic progress, (3) calculation process for the estimation of breeding values (EBV) from phenotypic/pedigree data sets, and (4) building index selection with the combination of appropriate parameters using Best Linear Unbiased Predictors (BLUP). Day long farm visits and workshops were conducted in the Agriculture Experimental Farm Pilcaniyeu-INTA and Pilcañeu farm guided by Dr Joaquin Mueller and Dr Franca Bidinost, respectively.

The course participants highly appreciated the course content, presentation skills of the lecturers and the local organization by INTA personnel.

Stories

Differentiating Transboundary Animal Diseases in a Single Test

Peste des Petits Ruminants (PPR) is a highly contagious disease of small ruminants, which endangers the lives of sheep and goats in more than 70 Asian and African countries, as well as the livelihoods of their owners. PPR spreads very quickly from animal to animal, through direct contact, movement of infected animals or contaminated material. Early detection and confirmation of the disease is essential for its effective control and eradication.

Following the successful global eradication of rinderpest in 2011, the eradication of PPR by 2030 has been set as a goal by the Food and Agriculture Organization of the United Nations (FAO) and the World Organization for

Animal Health (OIE). The IAEA, in partnership with the FAO through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, has developed a multi-pathogen assay at its Animal Production and Health Laboratory in Seibersdorf, Austria, that was validated in collaboration with veterinary laboratories from the VETLAB Network. The assay simultaneously detects the PPR virus and other pathogens causing similar signs of disease. Thanks to this innovative method, Member State scientists are now able to diagnose diseases more efficiently, both in terms of time and costs.



VETLAB Network scientists learn how to use the multi-pathogen assay

Specifically, the multi-pathogen assay focuses on microorganisms that cause respiratory diseases of small ruminants, such as PPR, capripox disease, pasteurellosis and contagious caprine pleuropneumonia. This new diagnostic assay enables scientists to detect and differentiate the pathogens responsible for the four diseases in one single rapid test. In fact, these diseases have similar clinical signs in small ruminants, including fever and discharge from the eyes and nose, making it difficult to distinguish them clinically. "If diagnosticians only test for the most common respiratory diseases in their area, they might miss when PPR or other diseases enter their area," said Charles Euloge Lamien, a scientist at the Animal Production and Health Laboratory.

The assay was transferred to Member State scientists during a recent two-weeks training course held at the Seibersdorf laboratories. The participants were from Asian and African laboratories of the VETLAB Network, which operates at the national and international level. The Joint FAO/IAEA Division is actively coordinating and supporting this network of national animal disease diagnostic laboratories in 44 African and 19 Asian countries.

Multi-pathogen assays are rapid laboratory tests that look for different microorganisms (i.e. bacteria and viruses) responsible for animal diseases in one single reaction, thus saving time and money. The Animal Production and Health Laboratory uses these tests to diagnose the specific illnesses of sick animals as quickly as possible.



The new PCR diagnostic/BSL2 level molecular laboratory

Pathogens are the causative agents of infectious diseases; they can be passed easily from one animal to another. To properly treat the animals and contain the outbreak, the specific causative agent has to be identified. Since distinct pathogens may exhibit similar signs of disease, identification is not always possible based on clinical examination of the animals, which makes the laboratory test essential. Using the multi-pathogen assay, scientists can now determine exactly what pathogen is present using only one test.

Samples are first taken from the infected animals and then processed in the laboratory and analysed in a real-time polymerase chain reaction platform, which reveals the presence and the type of pathogen. <https://www.iaea.org/newscenter/news/differentiating-transboundary-animal-diseases-in-a-single-test>

Belize Takes a Big Step in the Control and Prevention of Animal Diseases

The IAEA started assisting Belize in 2010 in developing nuclear and molecular diagnostic techniques and strengthening capacities in animal health management through several initiatives, including the development of the Animal Health Molecular Diagnostic Laboratory. Project staff is being trained in molecular diagnostics of shrimp diseases, avian diseases and bovine diseases.

Aquaculture was prioritized by the Government of Belize as a tool to evaluate alternative sources of protein, and ultimately provide a cheaper protein source option for Belizeans. In this line, equipment and reagents and on the ground expert services were provided to the BAHA Belize City PCR laboratory for testing aquatic animal samples, especially shrimp. By the end of 2012, the PCR laboratory tested more than 500 samples and was successfully involved in inter-laboratory proficiency tests (ring tests).

In 2012, the Government of Belize, through additional assistance of the Inter-American Development Bank (IDB) started the construction of a new PCR diagnostic/BSL2 level molecular laboratory. On 22 July, 2015, the Belize

Agricultural Health Authority inaugurated its new PCR facility in Central Farm in the Cayo District. The laboratory's importance was highlighted during this event as it will continue to cater for aquatic and terrestrial diseases diagnosis, with focus on enhancing cattle, swine and poultry health. Most of the equipment was provided by the IAEA through TC Projects BZE5006 and BZE5007.

The PCR laboratory is engaged in avian influenza (AI), Newcastle disease (NDV) and several aquatic diseases' diagnoses. Collaboration with neighboring countries gave rise to Mexican experts visiting Belize and providing additional technical assistance on molecular diagnostic techniques. The equipment and experienced obtained are strengthening their ability for the early and efficient detection and control of animal diseases of economic importance. By this means, the PCR Laboratory was able to identify, characterize and report Low Pathogenic Avian Influenza (LPAI H5N2) positive samples for the first time in January 2016.

The PCR laboratory which started with a modest 50 samples to analyse now supports the diagnostic activity of the BAHA Central Farm activity with more than 5000 AI Agar Gel Immunodiffusion Test (AGID) assays, more than 5000 Brucella serological assays amongst the more than 15 000 samples received by BAHA Central Farm.

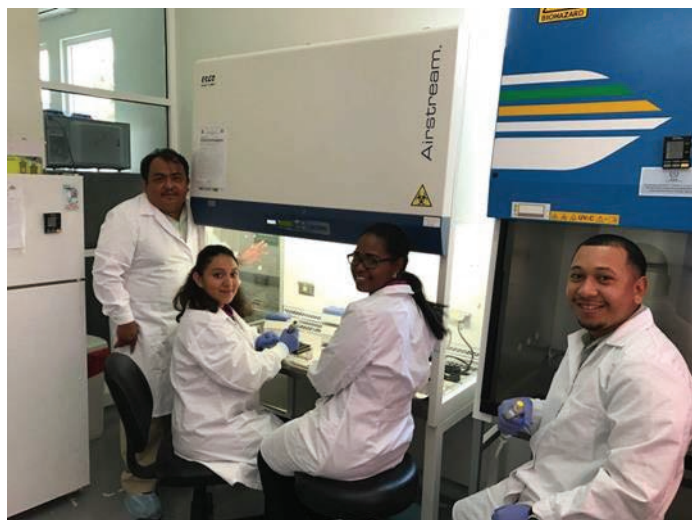


Collecting bio-hazard samples in suspected avian influenza hen

Several IAEA experts has provided on-site training and assistance to laboratory staff, not only on laboratory protocols, standard operating procedures (SOPs) and adequate use of specialized equipment but on ISO certification, quality management systems, and international regulations related to trade and animal health control.

Since September 2016, the Animal Health PCR laboratory performed several Avian Influenza and Newcastle disease assays on avian swabs from backyard poultry farms of the southern district of Belize, resulting positive to Newcastle disease by Real time reverse transcription (RRT)-polymerase chain reaction (PCR) [RRT-PCR] (Avian paramyxovirus serotype-1 [APMV-1]). These samples

were referred to the National Veterinary Services Laboratory (NVSL) in Ames, Iowa in the USA (OIE reference laboratory) for confirmation, where the NDV was characterized as virulent Newcastle disease virus by fusion protein cleavage site analysis.



Collecting bio-hazard samples in suspected avian influenza hen

NVSL's PCR results perfectly concurred with the Belize's Animal Health PCR laboratory results. Disease control measures were implemented to mitigate and control the outbreak. In February 2017, two other virulent cases were confirmed by the Animal Health PCR laboratory, one of them occurring near the Guatemalan border.

Belize participated in an Inter-Laboratory Comparison Testing for Classical Swine Fever organized by the Caribbean Animal Health Network (CARIBVET) and Centro Nacional de Sanidad Agropecuaria (CENSA) of Cuba with excellent results. The swine industry plays an important role in providing a safe source of food for the country. The Newcastle experience confirms the laboratory competence that is available in-country for the diagnosis of Avian Influenza and Newcastle disease. Dr. Miguel DePaz, Director of the Animal Health PCR laboratory indicates that the "IAEA's TCP projects for Belize have proven highly beneficial for the country". The laboratory plans, with IAEA assistance, to expand its diagnostic capabilities to include other transboundary animal diseases.

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

The Viet Nam National Centre for Veterinary Diagnosis Enhances Transboundary Animal Diseases Diagnostic Capability

Viet Nam is facing problems with several animal diseases. Many of them, including transboundary animal diseases

(TADs) are emerging, re-emerging and causing a significant economic impact on livestock production, food supply and trade. The poor sanitary condition and weakness of veterinary diagnostics laboratories are factors involved in the growing prevalence of TADs. More efficient approaches, tools, and strategies for proper and accurate diagnosis of animal diseases are required. The IAEA is helping Viet Nam to enhance its TADs and zoonotic disease diagnostic capabilities.



Sample processing for the diagnosis of transboundary animal diseases at NCVD

The National Centre for Veterinary Diagnosis (NCVD) has been recognized as the leader of veterinary diagnostic laboratories in Viet Nam since 1953. The centre depends on the Department of Animal Health (DAH), part of the Ministry of Agriculture and Rural Development and it is responsible for diagnosing animal diseases in addition to helping the DAH to make decisions on measures for the prevention and control of animal diseases. In 2016, the NCVD tested about 70,000 samples submitted by DAH offices, farmers, companies, etc, to detect possible pathogens affecting livestock. Among the tested samples, 77 positive cases from 34 outbreaks of foot-and-mouth disease (FMD) type O were identified in both swine and cattle from 13 Northern provinces of the country. The number of FMD positive samples had increased in comparison to 2015. Porcine reproductive and respiratory syndrome virus (PRRSV) was identified in pigs from both traditional and model farms. *Theileria orientalis* was identified for the first time in imported cattle in Viet Nam. In addition, there were some positive cases identified for classical swine fever, rabies, goat pox and *Clostridium perfringens*.

NCVD has carried out field activities on the surveillance of FMD, classical swine fever and post-vaccination monitoring of Highly Pathogenic Avian Influenza (AI) HPAI-H5N1 and FMD; as well as quality control of vaccines against AI, FMD and avian coccidiosis. However, outbreaks of some TADs such as goat pox, *Clostridium* spp., leptospirosis and vector-borne diseases frequently occur in pig and poultry farms. The laboratory diagnoses of these diseases are well implemented by using the classical or traditional methods but with limitations in accuracy and turnaround times. The nuclear-related

technologies such as ELISA and PCR, which improve the early and rapid diagnosis of animal diseases, although active, are not yet utilized to their full potential at NCVD.



Laboratory facilities at NCVD

The IAEA project VIE5019 awarded to NCVD is the first project to increase the serological and molecular nuclear and nuclear derived early and rapid diagnoses and control of transboundary animal and zoonotic diseases. The focus of this project will be to strengthen research and diagnostic capacities especially by implementing and developing new technologies for goat pox, *Clostridium* sp., Leptospirosis and vector-borne diseases. Based on the demand of NCVD, IAEA technical experts carried out visits to advise on how to improve serological and molecular diagnostic techniques for TADs. The IAEA has purchased equipment for nuclear-related techniques to detect a number of TADs. All equipment involving molecular and serology techniques such as Real-time PCR, electrophoresis, ELISA readers as well as reagents, primers, probes and consumables have been implemented in international laboratories and a local training course will be organized to improve knowledge and hands-on on laboratory techniques for staff.

The IAEA's support to NCVD is of great importance to the institute and Viet Nam.

Bangladesh Continues to Achieve a High Growth in the Livestock Industry

Jayonta Bhattacharjee, M. Musharraf Uddin Bhuiyan

Department of Surgery and Obstetrics, Bangladesh Agricultural University, Mymensingh

Bangladesh has had a consistently high growth in its livestock industry over the last decade. From 2006 to 2016, the country has achieved more than a 3-fold increase in milk production (from 2.28 to 7.28 MMT) and nearly 6-fold increase in meat production (from 1.04 to 6.15 MMT). Livestock's share of the national GDP has demonstrated a clear increase, 2.68% in 2012 to 3.21% in 2016. This rapid growth in the industry has been due

among other things to a rapid dissemination of artificial insemination (AI) services and adaptation of better animal health care and feeding practices. Bangladesh performs as many as six million inseminations in cattle every year with coverage of 44% of the national breeding cattle herd. Much of the potential of the country's 24.5 million cattle remained unexplored; many fold increase in milk and meat production can be achieved, provided that a systematic genetic evaluation and selection process is put in place and advanced technologies are adapted in animal health care and feeding practices.



Central bull mother herd of DLS

With support from the Joint FAO/IAEA Division and the Technical Cooperation Department of the IAEA, Bangladesh Agricultural University (BAU) through its departments of Surgery and Obstetrics (DSO), Pathology and Animal Breeding and Genetics and the Department of Livestock Services (DLS), are being strengthened by improving laboratory capacities for the introduction of genomic selection of superior animals for breeding and application of nuclear derived molecular techniques for early and rapid diagnosis of transboundary animal and zoonotic diseases.



PPR vaccine laboratory

BAU leads human resources and technology development to enhance livestock production



A private dairy farm with crossbred cows

The DSO has remained the prime location in the country for validating assisted reproductive technologies, involving AI and embryo transfer, and disseminating those to farmers and other stakeholders. The adaptation of ELISA and radioimmunoassays for reproductive hormones and Artificial Insemination Data Application (AIDA) have been important for the enhancement of AI service quality to farmers and rapid dissemination of improved animal genetics.

In addition, DSO has trained 1189 insemination technicians and 625 community veterinary health workers. These trainings were funded by BRAC, CARE Bangladesh, Community-based Dairy Veterinary Foundation (CDVF), DFID funded Chars Livelihoods Programme (CLP) of Bangladesh, and Haor Infrastructure and Livelihood Improvement Project (HILIP) of the Local Government Engineering Department, Bangladesh. The DSO runs a continuing education programme on reproductive health management of cattle and through this as many as 95 practicing veterinarians have been trained.

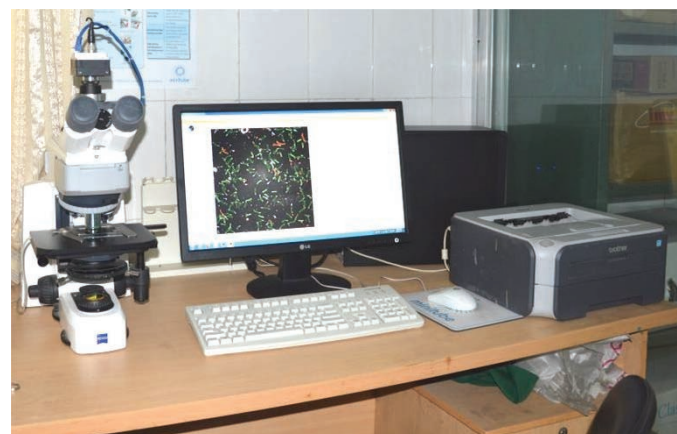
The research and development activities of the DSO are being extended to cattle farmers through the creation of the CDVF. Apart from delivering on-farm productivity enhancement services, the CDVF has trained 2900 smallholder dairy farmers and 50 field workers on dairy farm management with emphasis on udder hygiene and neonatal care.

Bangladesh builds capacities in nuclear and nuclear derived molecular techniques in animal production and health

In collaboration with the DLS, BAU has strengthened its capacities on collection, storage and analysis of pedigree, phenotypic and genotypic data from a minimum of

1000 elite cows as potential bull mothers for producing breeding bulls with superior genetics. As a way forward to implement genomic breeding value estimation, the immediate objective is to conduct genetic admixture and parentage analysis of crossbred animals. Nearly 9.0 million crossbred cattle (35% of 24.5 million) are in Bangladesh with unknown genetic potentials. The admixture and parentage analysis will enable breeders to select superior animals better suited to meet the production goals.

The Pathology Department of BAU takes the lead in the research and development (R&D) of nuclear and nuclear derived molecular and serological techniques for early and rapid diagnosis of transboundary animal and zoonotic diseases. The Department has been involved in R&D for the development of irradiated vaccines against respiratory diseases of goats – the second most important livestock species relevant to rural livelihoods.



Computer assisted semen analysis system

The DLS continues striving for the prevention and control of animal and zoonotic diseases. It produces 215.7 million doses of vaccine against poultry diseases and 16.0 million against animal diseases every year. Using its Central Disease Investigation Laboratory (CDIL) and nine Field Disease Investigation Laboratories (FDILs), DLS uses ELISA and PCR techniques for the diagnosis of animal diseases. The Joint FAO/IAEA Division has been supporting DLS in improving the quality assurance of its vaccines and accreditation of the diagnostic tests for animal diseases.

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 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.

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 local conditions, which will be correlated with genomic PTAs of sires at their origin. The second RCM will be held in late 2018 aiming at a midterm evaluation of the CRP and finalizing 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. The first research coordination meeting (RCM) was held during 23–27 January 2017 at the Vienna International Centre, Vienna, Austria.

During the first phase of the CRP, a minimum of eight mature cattle/yaks will be penned and fed with a known set of five pasture/browse fresh grasses. Half of the animals will receive 10% extra of maintenance levels and the other half will be fed *ad libitum*. During the enclosure, feed composition and feed intake will be recorded, n-alkane will be orally administered, and feeds and faecal samples will be collected. This procedure will be conducted in two

major seasons within 18 months. RC holders will report progress done based on these work plans in the 2nd RCM by the first quarter of 2019. Based on results obtained, additional research activities will be developed.

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 44 African and 19 Asian Member States which are dedicated to the sharing of knowledge and experience and to supporting each other during the implementation of international standards, routine diagnostic procedures, diagnostic approaches for specific disease outbreaks, thus facilitating emergency preparedness and response to animal health emergencies. The concept of networking proved very successful during the rinderpest eradication campaign. Nowadays, this concept has resulted in great successes in some of the Member States where diagnostic laboratories have received the ISO 17025 accreditation. Additionally, several other laboratories in this network are in advanced phases of implementation of the ISO 17025 standard and expect accreditation soon.

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 upgrading of the laboratory networks is of utmost importance for the planning and the initiation of proper contingency plans aimed at preventing and/or controlling threatening diseases.

The VETLAB Network aims to establish a unique regional/interregional communication and activity structure which enables the sustainable functioning and upgrading of the member laboratories under internationally recognized principles.

A critical step for harmonization of diagnostic techniques is the establishment of primary and/or secondary standards (as appropriate) which can be used as references during the calibration and maintenance of the diagnostic tests. The present CRP will target the establishment of such standards for use in serological and molecular diagnostic techniques and produce 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 (e.g. 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). The first RCM took place from 15 to 19 August 2016 in Vienna, Austria. The second RCM will take place from 7 to 11 August 2017 in Vienna, Austria.

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

Technical officers: Hermann Unger, Gerrit Viljoen

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

A recent consultant meeting on immunology agreed that vaccines against parasites will be a major breakthrough in livestock production as many of these parasites, in addition to the symptoms and performance reduction they cause can have immune compromising effect which can lead to other infectious diseases. So far, the irradiation of *Theileria*, *Haemonchus* and *Fasciola* has been addressed successfully and will now be followed up in this new CRP. *Theileria annulata* trials were successful and the same principle will now be tested with *T. parva* which causes East Coast Fever (ECF). A vaccine exists for ECF, but in ~20% of cases the vaccine can be a source of ECF or it does not induce adequate resistance. For *Haemonchus contortus* the expansion of production of the stage III larvae will be the major challenge. These irradiated larvae given orally lead to >99% protection. But the larvae have to be harvested from infected animals, which may be infected with other infectious organisms (*Fasciola hepatica* and *F. gigantica* are zoonotic parasites, i.e. they infect man as well). Preliminary experiments with irradiated larvae showed protection in terms of disease/ symptoms and prevent 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. The first RCM took place from 3 to 7 April 2017 in Vienna, Austria.

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 (CRP D3.10.28)

A 5000Rad whole genome radiation hybrid panel for dromedary camel

The dromedary (one humped) camel, with an estimated global population of 26.49 million (FAOSTAT, 2014), is one of the most popular domesticated species in regions experiencing harsh climatic conditions. These animals predominantly inhabit arid and semi-arid areas that are mostly unsuitable for crop and other livestock production. Camels are reared mainly for milk, meat, draught, racing, etc. and contribute significantly to the subsistence of many pastoral communities in Africa and Asia. Camel milk is fast gaining in popularity across markets in many countries with a good potential to improve the resilience of traditional pastoral systems. In spite of the opportunities for sustainable camel production, systematic breeding for genetic improvement is constrained by several factors like lack of animal identification, performance recording system and modern genetic/genomic tools and resources. Genomic resources for camelids have been limited except for the availability of whole genome sequence assembled to the scaffold level. However, there is significant gap in fine-scale high resolution mapping and chromosome level assembly of camelid genomes. Availability of such tools and resources will open the possibility of whole genome scans for genetic signatures, genome-wide association studies and development of genomic tools for breeding and

improvement of camels for increased productivity and adaptability.

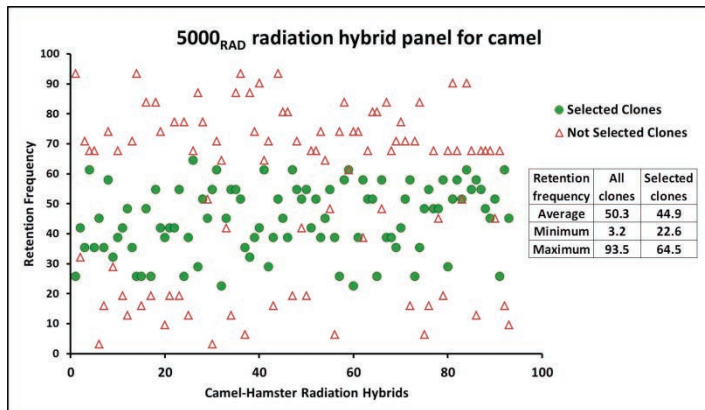


Figure. Frequency distribution of 5000RAD camel radiation hybrids based on the retention of donor (camel) genome

Radiation hybrid (RH) mapping has proven to be a reliable technique for producing chromosome level maps. Recent reports indicate that radiation hybrid data is extremely valuable while combining advanced sequencing and mapping procedures to produce highly accurate reference genome assemblies. The Animal Production and Health Laboratory (APHL) initiated the construction of camel RH panels in 2016 and now announces the availability of a 5000RAD panel containing 93 hybrids plus controls with an average retention frequency of 48%. Initially, a total of 186 radiation hybrid (5000RAD) clones were screened with a set of 44 custom designed PCR based markers derived from the dromedary genome. Thirteen of these markers showed higher discordant rates and were not considered for making decision on the selection of RH clones. Data on the remaining 31 markers showed that the retention frequency of all clones varied between 3.2% and 93.5% with an average of 50.3%. The final set of 93 clones had an average retention frequency of 44.9% ranging from 22.6% to 64.5%. The average retention frequency of camel radiation hybrids was higher than that of cattle, goat, pig, cat and duck and observed to be in an optimal range for high resolution whole genome mapping. This genomic resource is immediately available for use by Member States, particularly in constructing whole genome camel RH map, assisting camelid genome assemblies and developing genomic tools for camel improvement. The camel RH panel will be transferred to the International Camel Genome Consortium and other camel genome researchers upon request.

Implementing Global Plan of Action for Animal Genetic Resources (AnGR)

Genetic characterization of indigenous Sudanese cattle and goat breeds (SUD5036)

In continuation of the Joint FAO/IAEA Division's support in implementing the Global Plan of Action on animal genetic resources (AnGR), the APHL has supported genetic characterization of native cattle and goat breeds from

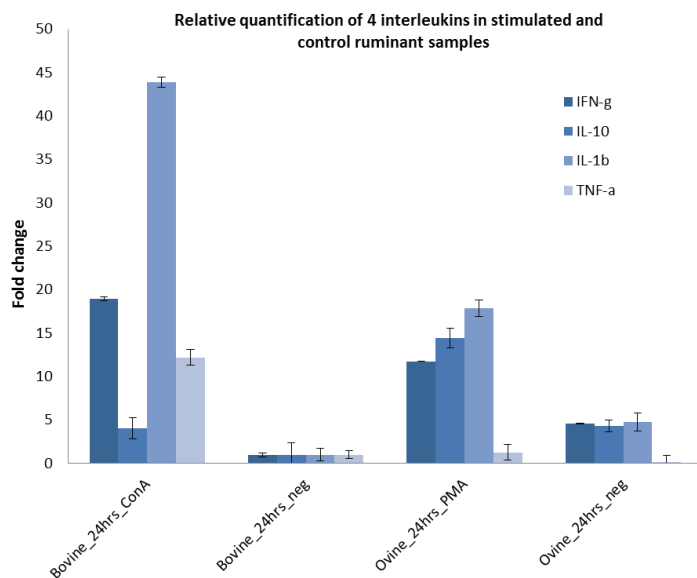
Sudan through the IAEA technical cooperation project (SUD5036). Two fellows Ms. Hiba Hamed and Mr. Mutaz Magboul Magboul were trained on molecular genetic characterization using nuclear and extra-nuclear DNA markers. Sudan possesses the largest cattle population in Africa that is largely classified into two groups: Nilotic cattle and North Sudan Zebu cattle. North Sudan Zebu cattle include several types like Kenana, Butana, White Nile, Baggara, Foja, Qash, Arashie cattle, Red Um Bororo, Ingessana cattle and Sudanese Fulani. Kenana and Butana are considered to have good potential for milk production compared to other cattle populations/ecotypes. However, much required information on the genetic potential of these animals especially genetic variability, level of inbreeding, physical and phenotypic characteristics, etc. are lacking. A total of 232 samples were collected from five major ecotypes of North Sudan Zebu cattle (Butana, Kenana, Foja, Baggara, Arashie) and Butana X Kenana crossbreds. All of the six populations were analyzed by sequencing control region (D-loop) of the mitochondrial genome and genotyping 27 microsatellite marker loci. Similarly, 141 samples from three indigenous goat breeds of Sudan (Nubian, Desert, Red Sea Hills) were analyzed for multi locus microsatellite and mitochondrial variations. Microsatellite genotypes revealed significant within breed genetic diversity in Sudanese cattle and goat breeds. Statistical analysis of data to elucidate genetic structure and phylo-geography is currently in progress.

Animal Health

Development of *in-vitro* Assays that Measure Vaccine Immunogenicity through the Use of Nuclear Related Techniques

In order to assist with projects that are participating in the CRP on irradiated vaccines (D3.20.33), the APHL has undertaken the development of experimental protocols that will measure the immunogenicity of vaccines during animal trials. The panel under development at Seibersdorf initially includes cytokine expression analysis by qPCR in sheep, cattle and goats as the priority. Four interleukins, IFN-gamma (IFN- γ), TNF-alpha (TNF- α), IL-10 and IL-1b have so far been tested using cells stimulated *in vitro* for interleukin production. Cytokine production and especially that of IFN-gamma by CD4 and CD8 T cells is a good indicator of cell mediated immunity induced by vaccinations against many intra- and extra-cellular pathogens. To develop this assay, the use of peripheral blood mononuclear cells (PBMCs) isolated from vaccinated animals is preferred as incubation for re-stimulation with the vaccine for several days is required to measure the range of cytokines produced by vaccinated animals. At the APHL, we harvested PBMCs from bovine and ovine blood and subsequently incubated the cells with either Concanavalin A (ConA) or phorbol 12-myristate

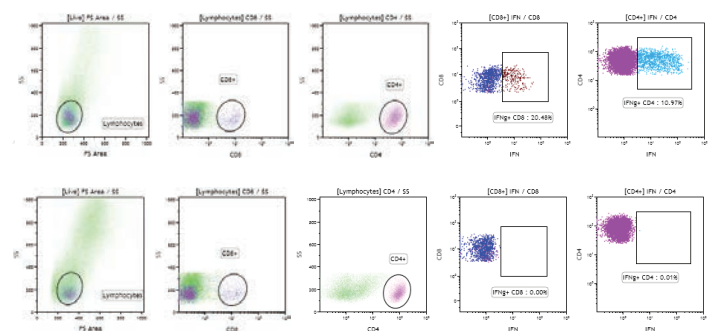
13-acetate (PMA), both strong stimulators of immune cells. Control cultures were maintained under the same conditions as treated cells. RNA was subsequently extracted from cells and used in a qPCR assay using SYBR green that measures IFN- γ , TNF- α , IL-1b and IL-10. This assay has been designed to use sets of primers that amplify the targeted interleukin in both bovine and ovine samples thus reducing cost and increasing efficiency. Activated cells displayed signature fold changes in interleukin expression as displayed in the figure below. This assay will be extended to include other cytokines that are important for innate and adaptive immunity, Toll-like receptors and cell signaling.



Fold change expression in ruminant PBMC stimulated using Concanavalin A (ConA) or PMA (phorbol 12-myristate 13-acetate) when compared to non-stimulated negative (neg) PBMC

Austria (AGES), the flow cytometer is located outside the containment area. Therefore, the APhL have optimized flow cytometric procedures that should be followed when handling cells inside a BSL-3 laboratory to ensure that these cells are devoid of any infectious pathogenic agents when moved out of the facility. During the optimization of flow cytometric procedures, practices adopted at other BSL-3 laboratories were used as the minimum standards for the fixation of cells [fixation of cells at 1% paraformaldehyde (PFA) for 18 hours]. However, in our experiments, we increased the level of safety by fixing cells at 4.2% PFA prior to removal from the pathogen containment facility after surface staining of cells. We still we able to preserve the intensity of surface staining and were able to carry out intra-cellular staining following fixation (see figure below). These optimized protocols will aid the APhL to work on developing irradiated vaccines to livestock pathogens that are important to many developing nations (Related to CRP D32032 “Irradiation of Transboundary Animal Disease Pathogens as Vaccines and Immunity Inducers”).

Figure: Sheep whole blood was lysed using ACK and total leukocytes were cultured overnight in 24 well plates (5x10⁶ cells/ml) in RPMI1640 supplemented with FBS at AGES (BSL-3). Then cells were stimulated with PMA/IO (top panel) or without (lower panel) for 4 hours. Cells were harvested and stained for surface staining (CD4, CD8 and live/dead stain). Next cells were fixed overnight with 4.2% PFA (18 hours at 4°C). Next morning cells were transported back to the APhL (Seibersdorf) in the same fixation solutions. Then cells were permeabilized and stained for IFN γ . Acquisition was done the same day.



Standard Practices for Flow Cytometry Procedures at Higher Biosafety Level Laboratories

Containment of highly pathogenic and non-endemic disease agents is essential in research environments and regulated by national legal frameworks and also according to international standards. The majority of such agents are classified at or above BSL/ABSL-3. The APhL is constantly engaged in working with pathogens classified at BSL-3 since many livestock diseases that prevail in developing nations are foreign to Austria and the European Union. Flow cytometry is a technology that is employed to study the phenotypic and functional characteristic of cells in a highly efficient manner. This technology becomes very important when measuring vaccine responses during development stage and also in established vaccines. Thus the use of flow cytometry is desired in some situations while working with tissues that have to be contained within BSL-3 due to their interaction with classified agents. However, as in the case of the only BSL-3 laboratory in

Molecular Epidemiology of ASF

The APhL is supporting the efforts of several African Member States to tackle African swine fever (ASF) by reinforcing the local laboratory capacities to detect and perform in-depth analysis of the ASF virus. Since 2012, there has been an increasing demand from Member States, Cameroon, Central African Republic, Chad, Senegal, Democratic Republic of Congo (DRC), Ethiopia, Nigeria, Burkina Faso, Zambia, Cape Verde, Mozambique, Tanzania, Cote d'Ivoire and Mali, to assist them in

characterizing their local isolates. As part of the APHL's support to DRC, a comprehensive characterization of ASF isolates in the country was undertaken between 2013 and 2016. The result which was recently published in the journal "Viruses" (Viruses 2017, 9/2, 31; doi:10.3390/v9020031), showed the co-circulation of three ASFV genotypes: I, IX and XIV with the genotypes IX and XIV being reported for the first time in this country. Furthermore, a closer look at the DRC ASFV isolates through the analysis of the central variable region of the virus, revealed a high diversity among these isolates, with 19 identified variants. This significant number of variants within a single country highlights the difficulties in finding a single effective vaccine strain with broad protection against ASF.

In contrast to what was observed in DRC, the characterization of ASFV isolates from samples collected in Burkina Faso until 2016 and recent outbreaks in Mozambique (2016 and 2017) have shown the circulation of only one ASF genotype in each of these countries. All ASFV from Burkina Faso belong to genotype I with five CVR variants and those from Mozambique belong to genotype II with only two CVR variants.

Currently APHL is undertaking a comprehensive characterization of CDv2 gene of ASFV from various genotype and geographical locations in Africa. The CDv2 gene has been reported to carry information that allows the determination of ASFV serotypes. The analysis of this gene will allow a better understanding of the diversity of ASFV isolates in the African continent.

Improved Diagnostics for Peste des Petits Ruminants

Peste des Petits Ruminants (PPR) is a highly contagious viral disease of wild and domestic small ruminants. The disease can cause serious clinical signs in sheep and goats, often leading to death in 80–100% of the most severe cases.

PPR virus is a RNA virus and, as such, is subjected to high genomic variability, creating a challenge in its detection by PCR. To improve PPRV detection, APHL is working in collaboration with Member State veterinary laboratories in Cameroon, Ethiopia and Nepal on a triplex assay for detection of PPRV. By targeting simultaneously two genes of the virus and including an internal control, this increases the chance of detecting all known PPRV variants, and avoiding false negative results. Once the analytical validation of the assay was completed, the method was further evaluated using 150 archived samples from different countries and belonging to all the four PPRV lineages. The assay is currently being transferred to several Member States. This assay will be very suitable in both PPR endemic areas and those at risk.

Transcontinental Spread of the Highly Pathogenic Avian Influenza H5 Viruses – IAEA at the Front Line to Support Member States

Highly pathogenic Avian Influenza (HPAI) viruses belonging to the H5 subtype continue to pose a threat for animal health and the livestock industry, and to raise public health concerns. In addition to the persistence of the H5N1 HPAI virus in some countries in Africa and Asia, the recently emerged reassortant viruses H5N8 and, to a lesser extent, H5N5 are persisting in the wild bird population and are responsible for the transcontinental spread of avian influenza in Asia, Africa and Europe.

Up to May 2017, 43 countries in these three continents have reported cases in birds, the majority in wild bird but cases have also occurred in commercial and backyard chickens. In contrast to H5N1 and H5N6, no human cases have been reported to be associated with the H5N5 and H5N8 HPAI virus strains circulating in Europe and Africa. According to the World Organization for Animal Health (OIE), the H5 HPAI viruses responsible for the ongoing outbreaks caused the destruction of approximately 31 million birds to date (May 2017), the majority in Asia, followed by Europe and Africa.

Similar to its predecessor H5N1, the H5N8 virus reached Europe and Africa crossing the Asian continent. In Africa, it caused outbreaks in Cameroon, Egypt, Niger and Nigeria. Unlike H5N1, H5N8 virus reached for the first time the Eastern part of Africa for the first time, affecting wild birds and poultry in Uganda in January 2017.

Following up on a request for support made by Uganda, IAEA in collaboration with FAO mobilized technical resources to support the National Disease Diagnostics and Epidemiology Centre (NADDEC) in Entebbe for the rapid diagnoses of avian influenza. The APHL in Seibersdorf immediately contacted the Ugandan laboratory to assess the situation and evaluate the needs. The shipment of all the necessary laboratory reagents, protocols and controls was quickly organized to allow for the rapid and specific testing of suspected samples at NADDEC.

The emergence and spread of novel subtypes, such as H5N8 and H5N5, has prompted the APHL team to evaluate the appropriateness of the laboratory protocols previously validated for other subtypes such as H5N1 and the performance of novel testing procedures for these emerging viruses. It is imperative for a testing laboratory to ensure the optimal performance of the test and the accuracy of the results. For this, proper controls are necessary. In the framework of the VETLAB CRP (D32032) and in collaboration with the FAO and OIE Reference Laboratory for Avian Influenza in Padua, Italy (IZSVe), the APHL has developed and distributed freeze-dried, inactivated virus control batches containing the most recent HPAI strains

(H5N5, H5N8) to Member States that require them. This enables Member State laboratories to implement testing procedures on their own ensuring at the same time the quality of the results.

In addition to the spread of the avian influenza viruses of the H5 subtype, the H7N9 avian influenza continues to persist and evolve in poultry in China. In addition to the poultry losses due to H7N9 infections, this virus keep on provoking a serious, often lethal disease in humans exposed to infected birds. To date, 14 June 2017, 1542 human cases have been confirmed since the emergence of this virus in 2013, causing 596 deaths.

Given the constant threat posed by avian influenza to animal and public health, the rapid evolution of the viruses and the epidemiological situation, a training course will be organized in collaboration with the IAEA Department of Technical Cooperation – Division for Europe- and FAO for the veterinary laboratories of the European, Caucasus and Central Asia region. The training course will aim at providing diagnosticians with state of art techniques relevant to the rapid and advanced diagnosis of avian influenza, detailed virus characterization and bioinformatics methods to investigate the evolution and molecular epidemiology of the virus.

Fellows/interns/consultants

Ms Juliette Elsan from University of Montpellier, France is being trained on ‘Rapid detection methods for transboundary animal diseases’ for six months (20 February, 2017 to 19 August 2017) under the IAEA internship program.

Ms Hiba Hamed from Animal Resources Research Corporation, Ministry of Science and Technology, Khartoum, Sudan was trained on ‘Genetic characterization of Sudanese indigenous cattle and goat breeds using DNA

markers’ for three months (24 January, 2017 to 21 April, 2017) under TC fellowship (SUD/16016).

Mr Mutaz Magboul Magboul from Animal Resources Research Corporation, Ministry of Science and Technology, Khartoum, Sudan was trained on ‘Evaluation of Sudanese sheep for prolificacy using DNA markers’ for three months (13 March, 2017 to 9 June, 2017) under TC fellowship (SUD/16001).

Mr Stephen Takudzwa Marambe from the Central Veterinary Laboratory in Harare, Zimbabwe, was trained on ‘molecular epidemiological methods, tissue cultures and production of biological reagents for the surveillance of livestock diseases’ for one month (2 May to 1 June 2017) under TC fellowship (ZIM/16019).

Mr Andrew Lanki Makgwa from the Botswana National Veterinary Laboratory in Gaborone, is being trained on immunological and molecular diagnosis of animal diseases for three months (2 May to 1 August 2017) under TC fellowship (BOT/14013).

Field support mission

Technical visit to State Central Veterinary Laboratory (SCVL), Ulaanbaatar, Mongolia, MON5023

The molecular multiplex method transferred to the State Central Veterinary Laboratory (SCVL) in Mongolia enabled the rapid detection of the recent PPRV outbreaks among livestock and wild life populations in the country. In this context, an expert mission was carried out in Mongolia from 21 to 27 May 2017 in continuation of the support to the veterinary laboratories of the country in the application and validation of molecular diagnostic and typing methods for the detection of pathogens in small ruminants and swine.

Technical Cooperation Projects

TC Project	Description	Technical Officer(s)
ALG/5/027	<p>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)</p> <p>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.</p>	<p>M. Shamsuddin I. Naletoski C. Lamien</p>

TC Project	Description	Technical Officer(s)
ANG/5/013	<p>Applying Nuclear and Molecular Techniques for Diagnosis and Control of Transboundary Animal Diseases</p> <p>Objective: To support veterinary services in the control of transboundary animal diseases.</p>	G. Viljoen I. Naletoski
BDI/0/001	<p>Supporting Human Resource Development and Nuclear Technology Support including Radiation Safety</p> <p>Objective: 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.</p>	I. Naletoski
BEN/5/007	<p>Soil, Crop and Livestock Integration for Sustainable Agriculture Development Through the Establishment of a National Laboratory Network</p> <p>Objective: An interdisciplinary project that aims at a sustainable intensification of peri-urban agricultural production through the integration of cropping-livestock systems was developed.</p>	M. Shamsuddin H. Unger
BEN/5/010	<p>Using Nuclear Techniques for Better Utilization of Local Feed Resources and Improved Reproduction Practices to Enhance Productivity and Conserve Nature</p> <p>Objective: To improve livestock productivity by using crop residue-based feedings and better practices of animal reproduction.</p>	M. Shamsuddin
BGD/5/030	<p>Building Capacity to Improve Dairy Cows Using Molecular and Nuclear Techniques</p> <p>Objective: To improve the productivity, health and reproduction of dairy cows using molecular and nuclear techniques.</p>	M. Shamsuddin G. Viljoen
BKF/5/014	<p>Improving the Productivity of Small Ruminants through Diet, Health and Identification of Genetic Markers for Selection and Breeding Management</p> <p>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</p>	M. Garcia Podesta M. Shamsuddin K. Periasamy
BKF/5/015	<p>Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived techniques</p> <p>Objective: To support the national and regional efforts to combat HPAI H5N1 outbreaks in Burkina Faso</p>	H. Unger I. Naletoski
BKF/5/017	<p>Using Modern Animal Breeding Methods, Nuclear and Genomic Tools to Improve Dairy Production in Smallholder Production Systems</p> <p>Objective: To improve the productivity of cattle through the application of genetic characterization, artificial insemination and control of zoonotic diseases.</p>	K. Periasamy M. Shamsuddin
BOT/5/015	<p>Establishing District Laboratories that use Nuclear and Molecular Techniques for Early and Rapid Diagnosis of Endemic and Transboundary Animal Diseases</p> <p>Objective: To improve diagnostic capacity of transboundary animal diseases like FMD, PPR, ASF, RVD 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.</p>	G. Viljoen C. Lamien

TC Project	Description	Technical Officer(s)
BZE/5/007	<p>Supporting Sustainable Capacity Building through Distance Learning for Laboratory Personnel of the National Agricultural Health Authority</p> <p>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.</p>	G. Viljoen
CAF/5/009	<p>Controlling Contagious Bovine Pleuropneumonia and Peste des Petit Ruminants</p> <p>Objective: To contribute to food security through improved animal health and production.</p>	H. Unger
CHD/5/005	<p>Studying the Causes of Pulmonary Diseases in Small Ruminants</p> <p>Objective: To contribute to poverty reduction and ensure the population's food security by increasing livestock productivity.</p>	H. Unger C. Lamien
CMR/5/019	<p>Using Nuclear Techniques to Improve Milk Production</p> <p>Objective: To improve breeding and disease control in cattle for increased milk production in Cameroon by utilizing nuclear techniques.</p>	M. Garcia Podesta M. Shamsuddin H. Unger K. Periasamy
ELS/5/012	<p>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</p> <p>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.</p>	M. Shamsuddin I. Naletoski
ERI/5/009	<p>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</p> <p>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.</p>	M. Shamsuddin
ETH/5/020	<p>Enhancing the Livelihood of Rural Communities through Addressing Major Zoonotic and Economically Important Small Ruminant Diseases</p> <p>Objective: To investigate and control major small ruminant and zoonotic diseases in Ethiopia.</p>	H. Unger C. Lamien
GHA/5/035	<p>Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique</p> <p>Objective: To support the national and regional efforts to combat HPAI H5N1 outbreak in Ghana.</p>	H. Unger I. Naletoski
HAI/5/007	<p>Strengthening national capacities for the early and rapid detection of Zika virus infections in Haiti</p> <p>Objective: To enhance the capacities and support the response to Zika outbreaks through early and rapid detection of patients with Zika virus.</p>	I. Naletoski

TC Project	Description	Technical Officer(s)
INT/5/155	<p>Sharing Knowledge on the Sterile Insect and Related Techniques for the Integrated Area-Wide Management of Insect Pests and Human Disease Vectors</p> <p>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.</p>	I. Naletoski
IVC/5/034	<p>Monitoring Epidemiology of Transboundary Animal Diseases</p> <p>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.</p>	H. Unger
IVC/5/037	<p>Enhancing Diagnostic Capacity for HPAI H5N1 Avian Influenza, using nuclear-derived technique</p> <p>Objective: To support the national and regional efforts to combat HPAI H5N1 outbreaks in Cote d'Ivoire.</p>	I. Naletoski H. Unger
IVC/5/038	<p>Studying Small Ruminant Respiratory Diseases</p> <p>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</p>	H. Unger G. Viljoen
KAM/5/002	<p>Using Nuclear and Molecular Techniques to Improve Animal Productivity and Control Transboundary Animal Diseases</p> <p>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.</p>	G. Viljoen M. Garcia Podesta M. Shamsuddin
KAM/5/003	<p>Supporting Sustainable Livestock Production</p> <p>Objective: To improve animal production through applications of modern breeding technologies and improved feeding.</p>	M. Shamsuddin M. Garcia
KEN/5/033	<p>Using an Integrated Approach towards Sustainable Livestock Health and Nutrition to Improve Their Production and Productivity for Enhanced Economic Development</p> <p>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.</p>	M. Shamsuddin
LAO/5/003	<p>Using Nuclear and Molecular Techniques for Early and Rapid Diagnosis and Control of Transboundary Animal Diseases in Livestock</p> <p>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.</p>	G. Viljoen
LES/5/003	<p>Using Nuclear and Molecular Techniques for Improving Animal Productivity</p> <p>Objective: To improve livestock production.</p>	G. Viljoen

TC Project	Description	Technical Officer(s)
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 will assist the elaboration of a national strategy for control of the disease by formulating vaccines which are currently imported from Botswana.	I. Naletoski C. Lamien
MLI/5/026	Improving the Diagnosis of Livestock Diseases Objective: To improve animal health by implementing a control programme to tackle the major prevalent animal diseases in Mali.	I. Naletoski C. Lamien
MLI/5/027	Using Nuclear and Molecular Techniques for Early and Rapid Diagnosis, Epidemiological Surveillance and Control of Transboundary Animal Diseases Objective: To reduce TAD impact on the development of the livestock sector in Mali.	I. Naletoski C. Lamien
MLW/5/002	Strengthening Capacity for the Diagnosis, Prevention and Control of Animal Diseases of Public Health Importance Objective: To establish nuclear related diagnostic systems and tools (serological and molecular) for the screening and rapid diagnosis (both field and laboratory) of important animal diseases for veterinary public health.	H. Unger

TC Project	Description	Technical Officer(s)
MNE/5003	<p>Improving Diagnosis of Animal Diseases and Food Pathogens</p> <p>Objective: To improve the response to animal health and food safety challenges in Montenegro.</p>	I. Naletoski
MON/5/020	<p>Improving the Health Status of Livestock by Developing a Technology to Produce the Vaccine and Diagnostic Kit for Transboundary Animal Diseases</p> <p>Objective: To improve the health status of livestock by developing a technology to produce the vaccine and diagnostic kit of transboundary animal diseases.</p>	H. Unger G. Viljoen
MON/5/021	<p>Improving the Productivity and Sustainability of Farms Using Nuclear Techniques in Combination with Molecular Marker Technology</p> <p>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.</p>	M. Shamsuddin
MON/5/022	<p>Implementing Early Diagnosis and Rapid Control of Transboundary Animal Diseases, Including Foot-and-Mouth disease (FMD) and Peste des Petits Ruminants (PPR)</p> <p>Objective: To enhance early and rapid diagnosis of Transboundary animal diseases, including FMD and PPR.</p>	H. Unger G. Viljoen
MOR/5/034	<p>Improving Veterinary Drug Residue Detection and Animal Disease Diagnosis with Nuclear and Molecular Techniques</p> <p>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.</p>	I. Naletoski
MOZ/5/005	<p>Strengthening the Sustainability of the Institution to Address Animal Diseases, Prevention, Food Safety and Animal Production Problems through Nuclear and Related Techniques</p> <p>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.</p>	G. Viljoen
MYA/5/024	<p>Supporting the National Foot-and-Mouth Disease Control Programme</p> <p>Objective: To increase productivity of the livestock sector by implementing sustainable strategies to control and eradicate Foot-and-Mouth Disease.</p>	G. Viljoen
MYA/5/026	<p>Improving the Livelihoods of Smallholder Livestock Farmers by Developing Animal Feeding Strategies for Enhanced Food Security</p> <p>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.</p>	M. Shamsuddin
NEP/5/002	<p>Improving Animal Productivity and Control of Transboundary Animal Diseases Using Nuclear and Molecular Techniques</p> <p>Objective: To improve livestock productivity for food security by integrated management of animal nutrition, reproduction and health.</p>	G. Viljoen I. Naletoski

TC Project	Description	Technical Officer(s)
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 Characterizing and Improving Productivity of Cattle by Enhanced Reproduction and Better Feeding Objective: To improve productivity of cattle by genetic characterization 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
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

TC Project	Description	Technical Officer(s)
RAF/5/068	<p>Improving Livestock Productivity through Strengthened Transboundary Animal Disease Control using Nuclear Technologies to Promote Food Security (AFRA)</p> <p>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.</p>	H. Unger C. Lamien
RAF/5/073	<p>Strengthening Africa's Regional Capacity for Diagnosis of Emerging or Re-emerging Zoonotic Diseases, including Ebola Virus Disease (EVD), and Establishing Early Warning Systems.</p> <p>Objective: To enhance control of emerging zoonotic diseases in the African region, through safe and accurate early detection of pathogens in wildlife and livestock.</p>	H. Unger I. Naletoski
RAS/5/060	<p>Supporting Early Warning, Response and Control of Transboundary Animal Diseases</p> <p>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.</p>	H. Unger
RAS/5/069	<p>Complementing Conventional Approaches with Nuclear Techniques towards Flood Risk Mitigation and Post-Flood Rehabilitation Efforts in Asia</p> <p>Objective: To improve the capacity to develop resilience/adaptation of agricultural production systems to flooding events.</p>	G. Viljoen / I. Naletoski C. Lamien
RER/9/137	<p>Enhancing National Capabilities for Response to Nuclear and Radiological Emergencies</p> <p>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.</p>	I. Naletoski
RLA/5/071	<p>Decreasing the Parasite Infestation Rate of Sheep (ARCAL CXLIV)</p> <p>Objective: To contribute to the sustainable increase in sheep production at the national and regional level.</p>	M. Shamsuddin
SEN/5/036	<p>Controlling <i>Mycoplasma mycoides</i> Infection — Contagious Bovine Pleuropneumonia (CBPP) and Contagious Caprine Pleuropneumonia (CCPP)</p> <p>Objective: To contribute to the enhancement of livestock production in Senegal.</p>	H. Unger
SEY/5/008	<p>Building Capacity for Diagnosis of Animal Diseases using Nuclear and related Techniques (Phase I)</p> <p>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.</p>	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

TC Project	Description	Technical Officer(s)
TUN/5/028	<p>Supporting Watering Strategies to Help Livestock Raised in Semiarid and Arid Regions Coping with Climate Change</p> <p>Objective: To characterize, analyze 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.</p>	M. Garcia Podesta I. Naletoski
UGA/5/035	<p>Improving Food Safety through Surveillance of Fish Diseases</p> <p>Objective: To avail credible information about trace metals and aflatoxins in fish.</p>	H. Unger C. Lamien
UGA/5/038	<p>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</p> <p>Objective: To improve the national capacity for control of transboundary 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.</p>	H. Unger
URT/5/027	<p>Improving Livestock Production and Productivity through Sustainable Application of Nuclear and Related Techniques</p> <p>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.</p>	M. Shamsuddin M. Garcia Podesta
URT/5/031	<p>Improving Indigenous Cattle Breeds through Enhanced Artificial Insemination Service Delivery in Coastal Areas</p> <p>Objective: To improve the productivity of indigenous cattle through enhanced artificial insemination (AI) services delivery in coastal areas of Tanzania.</p>	M. Shamsuddin
VIE/5/019	<p>Applying Nuclear Related Techniques for Transboundary Animal Diseases (TADs) Diagnosis</p> <p>Objective: To contribute to the control and prevention of Transboundary Animal Diseases (TADs) in Viet Nam.</p>	G. Viljoen V. Wijewardana
YEM/5/012	<p>Improving Diagnostic and Analytical Capabilities of the Central Veterinary Laboratory Including Residue Testing of Animal Products</p> <p>Objective: To enhance livestock productivity and quality by reducing the incidence of livestock diseases.</p>	H. Unger
ZAI/5/021	<p>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</p> <p>Objective: To support the sustainability of food security and poverty alleviation through animal diseases diagnosis and immunization.</p>	H. Unger

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

Publications

Special issue in Small Ruminant Research on ‘Genetic Diversity of Small Ruminants in Asia’



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Genetic Diversity of Small Ruminants in Asia

GENETIC DIVERSITY: International Commission on Animal Production and Health Institute International Atomic Energy Agency Austria

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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 Member States 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 44 African and 19 Asia and Pacific VETLAB partners.

APH has 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. The latest issue of the VETLAB Network bulletin can be found in the first pages of this Newsletter.

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