Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Animal Production & Health Newsletter

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To Our Readers

End of Year Meeting of Animal Production and Health Staff, December 2022

Dear colleagues,

This year has been quite hectic trying to cope with delayed or postpone activities due to the COVID-19 pandemic as well as to implement the planned FAO and IAEA 2022 programme of work and budget.

Progress has been made in transferring diagnostic tools for the early and rapid detection of zoonotic and transboundary animal diseases such as peste des petits ruminants (PPR), classical and African swine fever, Rift Valley fever, highly pathogenic avian influenza (HPAI), Contagious bovine pleuropneumonia (CBBP) among others. Considering the spread of African swine fever (ASF) in Europe, Asia, and the Caribbean region, the Animal Production and Health Laboratory (APHL) compared eight diagnostic *in vitro* assays for the detection of ASF virus validating and confirming their value for the routine detection of ASF.

In addition to ASF, Porcine Circovirus (PCV) received attention as it is associated with several disease syndromes in domestic pigs having a significant impact on global pig production and health. PCV-3 had not been identified in Africa previously until APHL evaluated archived DNA samples collected in Mozambique from pigs affected by ASF and found 7.5% positive for PCV-3. Moreover, archived DNA samples from Burkina Faso, Cameroon,

Cape Verde, Ethiopia, the Democratic Republic of the Congo, Mozambique, Nigeria, Senegal, Tanzania, and Zambia were screened by PCR for the presence of Porcine Circovirus-2 (PCV-2) identifying continent-specific clusters and evidence of independent viral introductions from Europe, North America and Asia.

Lumpy skin disease (LSD) has spread from Africa to several countries in the Middle East, Europe, and Asia affecting mainly cattle, with Nepal reporting the disease in buffaloes. APHL tested their samples by real-time PCR and then applied molecular mining tools confirming that Bhutan, Nepal and Myanmar LSD virus clustered with those from Bangladesh and India implying a common introduction source.

The development and field trials of irradiated vaccines are showing promising results, among them avian influenza subtype H5N1, H9N2 and ASF vaccines. Initial work has started to produce irradiated vaccines against LSD, Babesia and Theileria. As part of this research work, several strains of *Lactobacilli* are being tested to function as irradiated vaccine adjuvants.

On the animal production and breeding side, APHL supported Sri Lanka project counterparts in evaluating the population structure of endangered indigenous Jaffna sheep and its relationship with South Indian native breeds. Also, initial steps have been taken to identify genetic markers related to viral diseases in trout to support breeding selection and production in fish farms. Technical support is being given to Tunisia to assess the fungal contamination and mycotoxin levels in forage silage and their transmissibility in sheep and cow milk.

Twenty-two regional training courses and workshops were implemented this year, 12 of them in a virtual format, mainly in the first part of the year, plus five Research Coordination Meetings as part of ongoing Coordinated Research Projects. In addition, the APH sub-programme managed to publish 15 papers in scientific journals, many with the collaboration of counterparts.

The Animal Production and Health Section continues its efforts in developing early and rapid diagnostic tests for zoonotic and transboundary animal diseases. A novel multiplex real time PCR-based assay for the detection and differential diagnosis of abortive disease caused by important bacterial zoonotic agents (brucellosis, Q fever, listeriosis and leptospirosis) was developed, laboratory validated and transferred to Botswana, Indonesia, Lesotho, and Senegal.

In addition, the Animal Production and Health Section continues its focus on enhancing food security by supporting sustainable livestock production systems in developing countries. This is to be achieved by strategic and applied research, technology transfer and capacity building. The three principal components of the subprogramme are animal nutrition, animal reproduction, breeding, and genetics, and animal health. Animal production and health problems are identified, and solutions developed by strategically applied isotopic, nuclear, nuclear-based, and nuclear-derived tools, in conjunction with conventional technologies to:

- Characterize and optimally utilize the nutritional value of locally available feed and feed resources to enhance energy conversion whilst protecting the environment and minimizing greenhouse gas emissions;
- Enhance animal reproduction and breeding through the introduction of artificial insemination, embryo transfer and productive breed selection, and the characterization of livestock genetic make-up to drive the integration of locally adapted animal breeds with trait selected exotic breeds to satisfy the increasing demand for more and better-quality animals and animal products; and
- Assess and reduce the risk of transboundary animal and zoonotic diseases to livestock and livestock owners through the implementation of early and rapid diagnosis and control technologies and their use in national and international control and eradication programmes.

The above activities are complemented by tools developed for computerized data management in disease diagnosis and animal production, use of geographic information systems in management of farm resources and diseases, and distance learning through information communication technologies in the related areas. The FAO/IAEA Veterinary Diagnostic Laboratory (VETLAB) Network is instrumental for the development, validation and dissemination of technologies, know-how and expertise worldwide.

Mr Liang Qu, the Director of the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture (NAFA/CJN) retired at the end of October 2022 after serving 17 years in that capacity, assuring the Joint FAO/IAEA Centre (NAFA/CJN) went from strength to strength. His technical support and managerial skills will be missed. In the meantime, we welcome Mr Thanawat Tiensin and Ms Dongxin Feng from FAO to take this interim position as NAFA/CJN lead.

Finally, I would like to thank all project counterparts for their valuable contributions and to experts, consultants and institutions that have supported our R&D programme, not only in 2002 but throughout the years facilitating our work and making it more successful for the benefit of FAO and IAEA Member States. On behalf of the Animal Production and Health team I wish all of you and your families a prosperous 2023.

Gerrit Viljoen

Head, Animal Production and Health Section

ONE FAO TEAM AWARD 2022 WINNER

Joint FAO/IAEA Centre: staff members celebrate being recipients of the One FAO Team Award 2022

The FAO Director-General has selected the Joint FAO/IAEA Centre team as a One FAO Team Award 2022 winner.

The awardees were: 100 Young and 100 Young at heart employees from across all streams and offices for their exceptional accomplishment in serving the Organization, as well as 19 teams (comprised of over 1 500 colleagues) were also recognised for the One FAO Team Award for further breaking down organizational silos by promoting the spirit of collaboration across divisions and offices, as well as acknowledging teams that have contributed to a more innovative, responsible, effective and impactful FAO.

The 2022 Employee Recognition Awards ceremony took place on the 15 December 2022. The FAO Deputy Director General Maria Helena Semedo joined the award ceremony in Rome from a chilly Montreal to introduce Najat Mokhtar, Deputy Director General, Department of Nuclear Sciences and Applications International Atomic Energy Agency (IAEA), who spoke of the excellent teamwork happening between our Organizations.

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

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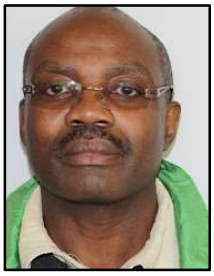
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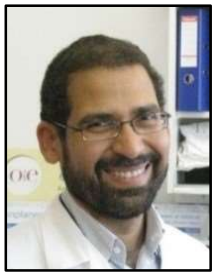
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Joint FAO/IAEA Programme

VETLAB Network Bulletin

01/2023

In this issue:

VETLAB is an initiative of the Joint FAO/IAEA Centre

To the readers

For the first time since 2019, the annual meeting of the Directors of the Veterinary Laboratories partnering the VETLAB Network was hosted on site, at the IAEA Headquarters in Vienna. This year, 29 directors from Africa and Asia participated, with only 3 attending virtually. Representatives of the FAO-Animal Health Service in Rome, Regional Office of FAO in Bangkok, the Pasteur Institute of Cambodia, and the ERFAN Network also attended. All the partners had the opportunity to present the achievements and challenges of their respective laboratories during the past year, promoting discussions on common issues, identifying possible solutions and priority areas for intervention. Sessions on international collaborations and initiatives were presented, creating opportunities for partners to develop ideas and projects for future activities. Special sessions were dedicated to zoonotic diseases and related global initiatives such as ZODIAC, and to activities and projects on antimicrobial resistance in livestock. More information on the outcome of this event can be found in the last issue of the newsletter.

Despite today's technology making it possible to virtually meet, the level of interactions, exchange and networking cannot be compared to an on-site event like this one. The pleasure to meet and sit together around the same table with colleagues and friends living and working in countries around the world is priceless, and creates a stronger sense of community. We thank all our VETLAB partners and supporters for making it possible and we wish you a healthy, peaceful and successful New Year!

VETLAB Highlights

Botswana National Veterinary Laboratory (BNVL) developed a multiplex HRM assay for the surveillance of zoonotic abortifacient agents circulating in cattle, goats, and sheep

Different pathogens may cause abortion and similar clinical signs in ruminants, thus a differential diagnosis is needed. BNVL, together with APHL, developed a rapid multiplex HRM real-time PCR to improve the detection and surveillance of main zoonotic abortifacient agents circulating in ruminant population, such as Brucella, Coxiella, Leptospira and Listeria. Standard Operating Procedures (SOPs) were prepared, and panels shipped to a number of VETLAB partners for further field validation.

5th Peste des Petits Ruminants Global Research and Expertise Network (PPR GREN) meeting

The meeting was organized by FAO and World Organisation for Animal Health (WOAH) in collaboration with the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) and held from 7-9 December, 2022, in Montpellier, France. Participants involved in PPR research activities, including some VETLAB Network partners and APHL, discussed and prepared recommendations on PPR-related research outputs.

The VETLAB Network supports AMR surveillance in Sri Lanka

The Bacteriology Laboratory, Veterinary Research Institute (VRI), Sri Lanka, has been identified as the National Repository of Antimicrobial resistance/Animal health by the Fleming Fund, UK. This laboratory is the national reference laboratory for pasteurellosis, black quarter, brucellosis and leptospirosis, and antimicrobial resistance (AMR).
Surveillance is the critical function of AMR in a country. However, due to limited funding, AMR surveillance has not commenced in Sri Lanka in the veterinary sector. In this regard, VRI received support from the VETLAB Network for the development and initiation of surveillance in Sri Lanka.

Unprecedented spread of highly pathogenic avian influenza (HPAI) H5N1 in the Americas

The H5N1 HPAI virus affecting many countries in Africa, Asia and Europe, is currently spreading in North, Central and South America causing several outbreaks and huge mortality in wild birds and poultry with consequent economic losses and impact on food security. The IAEA, in close coordination with FAO, is reacting to assist member states facing this unprecedented animal and public health emergency.

01/2023

VETLAB Network Bulletin

VETLAB Capacity Building Initiatives

Past Events

PPR Training Course on Early Diagnosis and Pathogen Characterization of Transboun-dary Animal Diseases: (IAEA, 19-30 September 2022). The course was aimed at strengthening the capacity of VETLAB Network partner laboratories in applying genomics tools for the accurate identification of pathogens. Scientists (n=29) from partner laboratories in Asia and Africa were trained on sample preparation and sequencing using NGS and nanopore sequencing and data analysis, focusing on ASF, Capripox, PPR, and Avian influenza viruses.

Training Course on Detection and Differential Diagnosis of PPR and Other Non-Conventional Hosts (IAEA 17-28 October 2022). The course aimed at strengthening capacities for diagnosing and monitoring PPR and other respiratory diseases in support to the implementation of the PPR GEP (PPR Global Eradication Programme).

Forthcoming Events

Workshop on laboratory methods for PPR diagnosis in francophone countries in West Africa (20-25 February 2023 in Abidjan). It is jointly organised by the FAO-Côte d'Ivoire Country Office and the FAO PPR GEP Secretariat staff in liaison with LANADA, AU-IBAR, and AU-PANVAC.

VETLAB Networking Activities

PPR Interlaboratory Comparison Test 2022

As for previous years, invitations to VETLAB partners laboratories to take part to this exercise were sent out last November. At present, 36 laboratories responded and will take part to the exercise. For those interested or for more information, please contact fao-iaea-ppr-proficiency-testing.contact-point@iaea.org.

VETLAB Network Laboratories:

Central Veterinary Laboratory (CVL) Corner Althea Road and Central distributor road, Manzini-Eswatini

As The Central Veterinary Laboratory (CVL) is part of the Department of Veterinary and Livestock Services. CVL it is the only national laboratory performing transboundary animal and zoonotic disease surveillance and diagnostic tests in Eswatini.

Sections in the laboratory include a post-mortem unit, and the laboratory units dealing with bacteriology, parasitology, serology and virology.

For the past 5 years, CVL has been supported by IAEA for diagnostic capacity building projects to improve the diagnosis and surveillance for zoonotic and transboundary diseases. The laboratory will be implementing soon confirmatory advanced techniques tests such as PCR and CFT for early detection and control to enable prompt response to disease outbreak.

The Bacteriology Laboratory is also benefiting from AMR grants of the Fleming Fund, designed to build laboratory capacity for improved bacterial culture, isolation and AST. CVL also took part in the TIKA project which capacitated the Serology Laboratory to enhance poultry diseases diagnosis and surveillance.

Notably, CVL successfully participated to external quality assurance exercises (proficiency tests, ring trials) such as: i) SADC regional inter laboratory proficiency testing (PT) for rabies; ii) Pirbright institute FMD proficiency testing schemes; iii) SADC Avian Influenza proficiency testing; iv) Bacteriology culture and AST PT by EQuAfrica and VetQAS; and v) Interlaboratory comparison for Peste des Petits Ruminants (PPR- Joint FAO/IAEA Centre). CVL is in an advanced stage of implementing the ISO/IEC 17025 Standard and applied for accreditation for same of laboratory tests.

For the next 3 years, the plan is to consolidate advanced molecular and serological techniques for early detection and control, strengthening staff skills, improving the biosafety in the laboratory and implementing the Laboratory Information Management System (LIMS).

More recent VETLAB publications

1. *Molini U, Franzo G, Settypalli TBK, Hemberger MY, Khaiseb S, Cattoli G, Dundon WG, Lamien CE. Viral Co-Infections of Warthogs in Namibia with African Swine Fever Virus and Porcine Parvovirus 1. Animals (Basel). 2022 Jun 30;12(13):1697. doi: 10.3390/ani12131697.*

2. *Franzo G, Dundon WG, De Villiers M, De Villiers L, Coetzee LM, Khaiseb S, Cattoli G, Molini U. Phylodynamic and phylogeographic reconstruction of beak and feather disease virus epidemiology and its implications for the international exotic bird trade. Transbound Emerg Dis. 2022 Jun 13. doi: 10.1111/tbed.14618.*

3. *Luka PD, Adedeji AJ, Jambol AR, Ifende IV, Luka HG, Choji ND, Weka R, Settypalli TBK, Achenbach JE, Cattoli G, Lamien CE, Molini U, Franzo G, Dundon WG. Coinfections of African swine fever virus, porcine circovirus 2 and 3, and porcine parvovirus 1 in swine in Nigeria. Arch Virol. 2022 Sep 22. doi:10.1007/s00705-022-05593-6.*

4. *Berguido FJ, Gelaye E, Liu Y, Davaasuren B, Krstevski K, Djadjovski I, Ivanova E, Goujgoulova G, Loitsch A, Tuppurainen E, Chibssa TR, Caufour P, Samojlović M, Lazić S, Petrović T, Vidanović D, Bertagnoli S, Grabherr R, Diallo A, Cattoli G, Lamien CE. Development and Optimization of Indirect ELISAs for the Detection of Anti-Capripoxvirus Antibodies in Cattle, Sheep, and Goat Sera. Microorganisms. 2022 Sep 30;10(10):1956. doi: 10.3390/microorganisms10101956.*

5. *Molini U, De Villiers M, De Villiers L, Coetzee LM, Hoebes E, Khaiseb S, Cattoli G, Dundon WG, Franzo G. Investigation and sequence analysis of psittacine beak and feather disease virus and avian polyomavirus from companion birds in Windhoek, Namibia. Acta Trop. 2022 Nov 11:106739. doi:10.1016/j.actatropica.2022.106739.*

6. *Molini U, Coetzee LM, Hemberger MY, Khaiseb S, Cattoli G, Dundon WG. Evidence indicating transmission of porcine parvovirus 1 between warthogs and domestic pigs in Namibia. Vet Res Commun. 2022 Dec 10. doi: 10.1007/s11259-022-10038-1*

Central Veterinary Laboratory (CVL), Eswatini

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Forthcoming Events

Regional Training Course on the Generic Verification of new SOPs in Buenos Aires, Argentina and Incheon, Korea (INT5157 ZODIAC, Pillar 1)

Ivancho Naletoski

Two regional training courses on the generic verification of the newly introduced standard operating procedures in the local laboratories will be held, the first from the 6 to 10 February 2023 in Incheon, Korea and the second from 6 to 10 March 2023 in Buenos Aires, Argentina.

The training courses are organized for the ZODIAC National Laboratories (ZNL) of the appropriate regions with a purpose to train the responsible operators (especially staff responsible for quality management) in determination and evaluation of the basic parameters for verification of the diagnostic procedures. Namely, a majority of the ZNLs use procedures developed at the appropriate reference laboratories. The ZNLs, as end users of these procedures, during the local implementation need to verify that the assays when performed in the local laboratories will perform equivalently as if they were used in the reference laboratories. The training courses will cover analytical sensitivity and specificity, accuracy, precision, repeatability and reproducibility, the use of reference materials and methods comparison, as well as participation and evaluation of proficiency testing schemes. The training will also cover the topics on the integration of the diagnostic procedures in the quality management system of the local laboratories.

Regional Training Course on Diagnostic Techniques for Avian Influenza and Newcastle Disease (RLA5085)

Carla Bravo de Rueda

The meeting is to take place at Laboratórios Federais de Defesa Agropecuária (LFDA), Sao Paulo, Brazil, from the 15 to 19 May 2023.

Twenty Latin-American and Caribbean countries will be participating in this event. They will be trained on the use of quantitative PCR for the diagnostic of avian influenza and Newcastle disease. This training will have a field and laboratory component simulating the scenario of an outbreak of these diseases.

Regional Introductory Meeting in Mauritius for the Strengthening of Biosecurity Practices in the Diagnostics of FMDV, AI, Brucella, PPR, RVF, CCHF and Rabies (RAF5089)

Carla Bravo de Rueda

The purpose of this event is to emphasize the importance of biosafety and biosecurity during diagnostics procedures. The selected zoonotic diseases as chosen by the counterparts will be explained with major focus on biosafety practices and essential diagnostic tools needed for their early diagnostics. This meeting will help us identifying gaps in the region and will re-focus our activities. We will also fine tune our workplan for the upcoming years.

Counterparts from Benin, CAR, Eritrea, Eswatini, Libya, Malawi, Mauritania, Mauritius, Seychelles and Sierra Leone will be present.

Joint Training on Genomics and Bioinformatics with FAO Region Asia Pacific and Joint FAO/IAEA Centre (MAL5034)

Carla Bravo de Rueda

A training course on genomics and bioinformatics training in avian influenza at the Malaysia Genome and Vaccine Institute is scheduled to take place in May 2023, exact dates will be confirmed when available. The purpose is to train participants on the use of the Minion platform in the diagnostics of Avian Influenza for Malaysian and Indonesians.

Group Delivery of Diagnostic Packages for Early Detection of Zoonotic Diseases at the Animal-to-Human Interface (INT5157 Pillar 1 of the ZODIAC Initiative)

Ivancho Naletoski

The first two phases of supply of the Zodiac National Laboratories with the appropriate equipment for serological and molecular detection and characterization of zoonotic pathogens was implemented during the second half of 2022. In total, for the first two phases thirty-eight laboratories were supplied (14 in Africa, 7 in Asia and Pacific, 9 in Europe and 8 in Latin America). Nine laboratories were selected as recipients of the next-generation sequencing (NGS) hardware platforms (3 in Africa, 2 in Asia and

Pacific, 2 in Europe and 2 in Latin America). The NGS laboratories will be supported in rapid implementation of appropriate technologies and bioinformatics, as well as regional centers for dissemination of the NGS knowledge and skills in their regions.

Map of the recipient laboratories of the diagnostic packages for early detection and characterization of zoonotic diseases (green spots: recipients from the first phase; blue spots: recipients from the second phase; grey spots: ZNLs which have still not been supplied / planned for the next phases)

Training Course on the Verification and Calibration of Bio-safety Cabinets in the Local Laboratories (RAF5082 and INT5157 Pillar 1 of the ZODIAC Initiative)

Ivancho Naletoski

Bio-safety cabinets are essential part of the bio-risk management in laboratories. They operate using a system of negative pressure and air filtering systems, which should ensure efficient filtration and inactivation of animal and zoonotic pathogens during sample processing and testing. However, both, the pressure and the filtering systems need periodical checkup, adjustment and/or change. These tasks are usually given to specially educated and certified operators, usually staff of the big production companies. Therefore, the periodical maintenance of the bio-safety cabinets is a demanding and costly process. To minimize these risks, APH has identified authorized experts which can train the staff of counterpart laboratories and offer a certification exam. With such a certification process APH expects to establish a network of certified staff in the local laboratories, thus enabling for cost-effective maintenance and improved biosafety in the local laboratories.

Training Course on the Techniques used for Detection and Characterization of Brucellosis (RAS5085)

Ivancho Naletoski

A regional training course on the techniques used for detection and characterization of brucellosis is planned from the 6 to 10 March 2023 in Bogor, Indonesia. All counterparts of the RAS5085 project were invited to submit applications for the training course. The course will cover theoretical and practical classes on the serological and molecular techniques for detection and characterization of brucellosis. Experts from the international reference laboratories will coordinate the course.

Training Course on the Techniques used for Detection and Characterization of Lumpy Skin Disease and Sheep and Goat Pox (RAS5085)

Ivancho Naletoski

A regional training course on the techniques used for detection and characterization of lumpy skin disease (LSD) and SGP is planned for 13 to 16 March 2023 in Kuwait. All counterparts of the RAS5085 project were invited to submit applications for the training course. The course will cover theoretical and practical classes on the serological and molecular techniques for detection and characterization of LSD and sheep and goat pox (SGP). International experts from the international reference laboratories will coordinate the course.

Past Events

First Research Coordination Meeting on Novel Test Approaches to Determine Efficacy and Potency of Irradiated and Other Vaccines (D32037)

Viskam Wijewardana and Carla Bravo de Rueda

The first Research Coordination Meeting (RCM) of Coordinated Research Project D32037 was held as a hybrid (virtual and on-site) meeting, from 18 to 22 July 2022, at the IAEA Headquarters in Vienna, Austria.

The first session of the RCM focused on the previous experiences of research contract holders (RCH) and proposed work plans. In the following session, the Animal Production and Health Laboratory (APHL) presented their activities on immunology, practical aspects to consider when using irradiation as a tool for developing livestock vaccines and on the life cycle of a vaccine, from good laboratory practices (GLP) to good manufacturing practices (GMP) using the influenza vaccine as an example.

Participants of the First Research Coordination Meeting of CRP D32037, VIC, Vienna, Austria

The individual discussions session was dedicated to improving work plans. During this session the following topics were discussed: how to identify and isolate pathogen strains as vaccine candidates; how to culture; how to determine the optimum irradiation dose; conduction of animal experiments including challenge experiments and assessment of immunological responses to vaccinations. Next, all the participants visited the APHL in Seibersdorf, conducted discussions with laboratory staff and had a tour of the laboratory. A round table discussion was held to identify any gaps in the proposed programs and to identify possible collaborations among participants. A plan was put forward to maintain swift communications among participants and to have a quarterly update on research activities.

Coordination Meeting of the Veterinary Diagnostic Laboratory Network with Directors of African and Asian Veterinary Laboratories

Charles Lamien and Giovanni Cattoli

The annual coordination meeting of the VETLAB Network was held from 22 to 26 August 2022 at IAEA Headquarters in Vienna.

Twenty-nine directors of VETLAB partner laboratories from Bangladesh, Botswana, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Eswatini, Ethiopia (2 participants), Ghana, Kenya, Lao PDR, Lesotho, Malaysia, Mali, Morocco, Mozambique, Myanmar, Namibia, Nepal, Niger, Senegal, Sri Lanka, Thailand (2 participants), Tunisia, UR Tanzania, Viet Nam, and Zambia participated in the meeting on site. DR Congo, Indonesia, and Mongolia attended virtually. Representatives of the Animal Health Services (AGAH), FAO, Regional Office of FAO (Bangkok), the Pasteur Institute of Cambodia, and the Enhancing Research for Africa Network (ERFAN-Italy) were also present.

The main objectives of the meeting were to:

(1) Update on VETLAB network activities and other initiatives of IAEA and partners on TADs and Zoonoses,

(2) Discuss common and individual country priorities and plans for 2022-2023,

(3) Discuss with VETLAB partner laboratories, the ways to enhance collaborative research on laboratory detection and surveillance of major TADs and Zoonoses.

In the first session, IAEA staff, FAO and ERFAN representatives presented laboratory capacity-building activities in Africa and Asia and the Global Leadership Laboratory Program. Then, VETLAB partners presented their challenges and successes, discussed gaps, and suggested solutions. Some sessions focused on zoonotic disease diagnosis and surveillance initiatives presented by VETLAB partners, followed by one-health approach where the Joint Centre presented the R&D strategy for ZODIAC and provided an update on R&D on zoonoses by the APH Laboratory.

During the discussion, the participants recognized that Multiplex PCRs are essential for syndromic surveillance and can help improve disease diagnosis and differential diagnosis. In addition, the network could also undertake a multicentric evaluation of freeze-dried reagents as an alternative to wet lab reagents and reduce issues related to the shipment and storage of wet reagents. Regarding NGS and third-generation sequencing, the participants highlighted the need to implement progressive steps for better adoption of nanopore sequencing.

The meeting participants recommended the Joint FAO IAEA Centre to:

- Continue supporting the implementation of the Quality System by facilitating access to reference material, including secondary standards and access to PTs for priority pathogens.
- Continue supporting capacity building and implementation of new technologies through training.
- Initiate collaborative research for the validation of assays for emerging diseases.
- Support scientific data sharing and publication.
- Promote reagent production and sharing by network members.

Meeting participants encourages VETLAB partner laboratories to:

- Continue to use sequencing services provided by the Joint FAO/IAEA Centre.
- Use multiplex PCR assays for syndromic surveillance and as motivation for sequencing.
- Participate in collaborative R&D in assay validation and molecular epidemiology.
- Use the procedures available on the iVetNet platform to calibrate and verify the major equipment.

Regional Introductory Workshop on Diagnostic Techniques of Transboundary Animal Diseases to Discuss Implementation of a Regional Plan in Latin America (RLA5085)

Carla Bravo de Rueda

The meeting was held at SENASA´s laboratories in Martínez, Buenos Aires and conference venue from 17 to 21 October 2022. The meeting was attended by 68 participants from 17 participating countries and 5 international and regional organizations, additionally over 20 IAEA officers, international experts and participants attended virtually. The Word Animal Health Organization (WOAH), Food and Agricultural Organization (FAO), Inter-American Institute for Cooperation on Agriculture (IICA), International Regional Organization of Plant and Animal Health (OIRSA), Pan American Center for Foot-and-Mouth Disease and Veterinary Public Health (PANAFTOSA-OPS/OMS) and the South American Diagnostic Laboratories for Avian Influenza and Newcastle Disease (RESUDIA) were participants as international and regional organizations.

The presence of these organizations was crucial for the discussion of regional challenges, going forward activities and coordination of the former. This event was the first regional meeting of veterinary diagnostic laboratories of the region of Latin America and the Caribbean and provided the opportunity for participants to establish a cooperation network related to 5 priority animal diseases (selected by project participating countries): classical swine fever, African swine fever, Newcastle disease, avian influenza, and brucellosis.

Main Counterpart (Costa Rica), hosts (Argentina) and representatives from IAEA, WOAH, IICA, OIRSA, PANAFTOSA/OMS/OPS, RESUDIA and FAO at the Regional Introductory Workshop on Diagnostic Techniques of Transboundary Animal Diseases in SENASA, Argentina

The event showed both, strengths, and opportunities for improvement of the technical capacities as well as the management practices of the laboratories, vital for sustainability of the diagnostic and surveillance activities. Additionally, there was an extracurricular visit to SENASA-Peru to visit their laboratories, analysis of needs and give suggestions for improvements.

Participants of the Regional Introductory Workshop on Diagnostic Techniques of Transboundary Animal Diseases in SENASA, Argentina

FAO Science and Innovation Forum

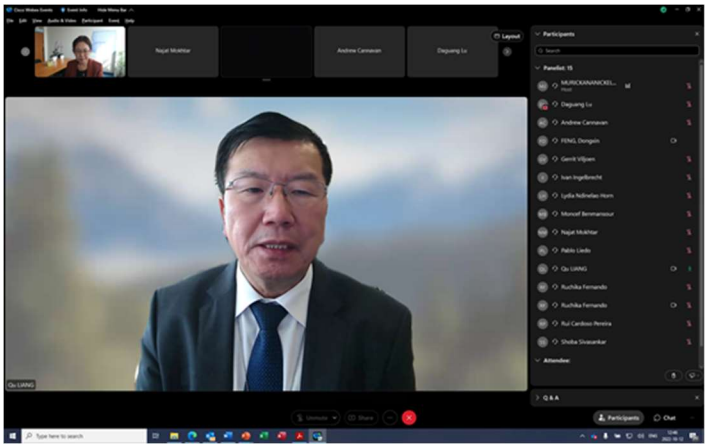
Victor Tsuma, Kathiravan Periasamy and Mario Garcia Podesta

The virtual side event "Nuclear Science and Innovation for Agrifood Systems Transformation: Success stories from the lab to the field and kitchen" was organized by the Joint FAO/IAEA Centre for Nuclear Techniques in Food and Agriculture on 12 October 2022.

The opening remarks were given by Najat Mokhtar, Deputy Director General of the Department of Nuclear Sciences and Applications, and by Qu Liang, Director of the Joint FAO/IAEA Centre. Shoba Sivasankar, Section Head of the Plant Breeding and Genetics Section, presented an overview of the programme of the Joint FAO/IAEA Centre,

whereas five scientists from Burkina Faso, Mexico, Morocco, Namibia and Sri Lanka highlighted the cooperation and technical support provided to their respective countries by the Joint FAO/IAEA Centre, detailing how nuclear and nuclear derived technologies have helped them improve and strengthen the research and development activities of their institutions towards supporting farmers and the public in food security.

Dr. Amadou Traore, from the Institut de l'environnmentet de recherches agricoles (INERA), Burkina Faso presented "Animal production and health practices to enhance food security".



Qu Liang, Director of the Joint FAO/IAEA Centre addressing the forum

Regional Training Course on Integrated Soil Cropping Livestock Production Systems (RAF5090)

Victor Tsuma

The regional training course on Integrated Soil Cropping Livestock Production Systems was held in Nairobi, Kenya from 28 November to 2 December 2022. The aim of the course was to discuss adoption of integrated soil-crop-livestock production systems/models for increasing agricultural productivity at the farm level using nuclear science and technology.

The 5-day training course was attended by forty-two participants from 13 African countries drawn from government ministries, research institutions, national agricultural development boards, and universities. Prof. Rogerio Mauricio (Federal University of Sao Joao Del Rey, Minas Gerais, Brazil), Dr. Oscar Kipchirchir Koech (LARMAT, University of Nairobi) and Victor Tsuma (Animal Production and Health Section, IAEA) were the facilitators.

The topics discussed included: principles/concept of integrated soil-crop-livestock integrated farming systems; systems thinking to enable sustainable agricultural productivity; models of integrated soil-crop-livestock production systems (ISCLPS); case studies on ISCLPS; and, socioeconomic impact of ISCLPS. A participatory learning approach was the basis of various modes of delivery of the training, including lectures, case-studies and a field trip. Customised group discussions were used to fine tune workplans for each participating country.

Participants of the Regional (AFRA) Training Course, with the project scientific consultant, Dr. Oscar Koech (standing on the extreme left) and expert from Brazil, Prof. Rogerio Mauricio (front row second left)

Workshop on Upscale Production of Irradiated Vaccines

On 14 November 2022, a workshop was conducted with the contribution of pharma industry representatives, to present the possibilities, approaches and challenges for up-scale production of irradiated vaccines. Approximately 50 scientists from member states participated in this event, including scientists involved in the agency's Coordinated Research Project on irradiated vaccines. Speakers from the industry sector made presentations on good manufacturing practices (GMP) production of vaccines and Animal Production and Health Laboratory (APHL) scientists made presentations on its irradiated vaccine program and vaccine evaluation. Scientists from the Fraunhofer Institute of Germany and the Texas A&M University, USA, made presentations on vaccine development by E-beam irradiation. An interesting discussion and several questions from workshop participants animated the session.

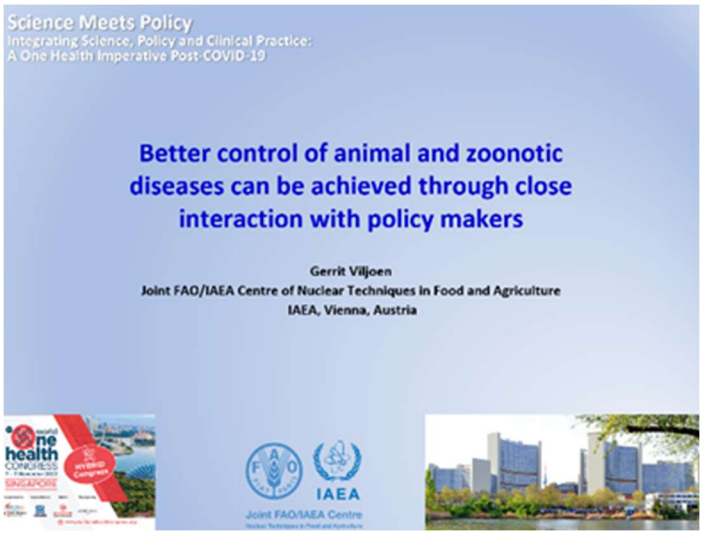
7th World One Health Congress 2022

Gerrit Viljoen and Mario Garcia Podesta

The event was organized by the SingHealth Duke-NUS Global Health Institute (SDGHI) in Singapore at the Sands Expo and Convention Centre from 7 to 11 November 2022 with the participation of more than 1 400 in-person and 1 000 virtual attendees from academic institutions, civil society, government bodies, private sector and multilateral organizations around the world. The congress sought to advance the global One Health movement to improve health and well-being by preventing and mitigating crises that originate at the animal-human-environment interface. The

event was opened by Dr. Tedros Adhanom Ghebreyesus, the Director-General of the World Health Organization (WHO), followed by opening remarks by Dr. Monique Eloit, the Director-General of the World Organisation for Animal Health (WOAH); and included keynote speeches, plenary lectures, scientific sessions with abstract presentations and panel discussions on urgent and emerging One Health topics. More than 120 speakers from over 60 countries presented their findings on a large number of disciplines.

Mr Gerrit Viljoen, Section Head of the Animal Production and Health Section of the Joint FAO/IAEA Centre participated in the panel discussion on "Science meets policy", his on-line presentation was on "Better control of animal and zoonotic diseases can be achieved through close interaction with policy makers".



Presentation to the One Health Congress

Coordination Meeting for the Implementation of Irradiated Vaccine Research Against Noda Virus Infection in Fish (TUN5032)

Viskam Wijewardana

Aquaculture production in Tunisia is responsible for the employment of 1 300 people and represents 13% of fisheries products. However, partly due to a lack of authorized veterinary products for medicinal treatment, the consequential disease outbreaks in farmed fish species can cost the sector up to 20% of its production value. The most appropriate method for controlling the spread of a disease in farmed fish species is to prevent it through vaccination. Irradiation-based vaccines have proven their superiority over other vaccination options. AquaVac-ir, a strong consortium of Tunisian researchers coordinated by the National Center for Nuclear Science and Technology (CNSTN) funded by Technical Cooperation Project TUN5032 by the IAEA. It is also composed of research groups from the Aquaculture Laboratory (National Institute of Marine Sciences and Technologies), the Laboratory of Venoms and Therapeutic Molecules and the Laboratory of Bioinformatics, Biomathematics and Biostatistics (Institute Pasteur of Tunis), and the Innov'COM Laboratory (Higher School of Communication of Tunis); with economic partners and also the support of national authorities and experts. A coordination meeting was held in Tunis, Tunisia, to launch this project and to educate the public and private sector stake holders. The IAEA and counterparts from Tunisia made the following presentations on vaccine development by irradiation: Vaccine forms based on immune–dominant antigens; Immunogenicity and reactogenicity of vaccines' signatures prediction; Metabolic networks modelling; In-silico platforms according to NF X50–900:2016; ISO 9001:2015; and Accreditation, quality management and digitalization in laboratories. The meeting was represented by FAO and WOAH.

Participants at the coordination meeting in Tunis, Tunisia

Training Course for Veterinary Diagnostic Laboratory Network Partners on Transboundary Animal Diseases: Early Diagnosis and Pathogen Characterization

Charles Lamien and Giovanni Cattoli

The training course was held from 19 to 30 September 2022 at the IAEA Laboratories in Seibersdorf, Austria.

The aim was to strengthen the capacity of the Veterinary Diagnostic Laboratory (VETLAB) Network partner laboratories' abilities to apply next-generation sequencing (NGS) and the relevant bioinformatics tools to accurately identify pathogens causing transboundary animal and zoonotic diseases. Over two weeks, the participants received training on sample preparation and sequencing using NGS and Nanopore, and the main steps involved in sequence analysis, with particular emphasis on animal pathogens' genome analyses focusing on African swine fever, Capripox, Peste des Petits Ruminants (PPR), and

Avian influenza viruses. The training was structured into two weeks, with the first dedicated to introducing NGS and the second introducing NGS data analysis. Thirty scientists from VETLAB partner laboratories in Asia and Africa participated in this course. Lecturers were from the West African Centre for Cell Biology of Infectious Pathogens (WACCBIP), Ghana, and the Joint FAO/IAEA Centre.

Regional Training Course on Bioinformatic Tools for the Detection of Molecular Markers Associated with Disease Resistance in Aquaculture (RLA5086)

Mario Garcia Podesta

The regional training course aimed to provide knowledge and share expertise on genetic improvement in aquaculture, bioinformatics and statistical analyses of genomic data for the identification of molecular markers associated with disease resistance in species of aquaculture importance. The course was implemented in two phases. The first part from 2 to 4 November 2022 was virtual and 17 scientists from Argentina (2), Brazil (3), Chile (2), Ecuador (3), Mexico (1), Peru (3) and Uruguay (3) participated. The second phase was in-person at the University of Chile, at the Casa Central and at the Facultad de Ciencias y Veterinarias y Pecuarias in Santiago de Chile, from 7 to 11 November 2022 and included the participation of 11 scientists from Brazil (2), Chile (2), Ecuador (2), Peru (2) and Uruguay (2).

Course participants evaluating statistical data

Dr. Baltasar Fernandes Garcia Neto (Brazil), temporary based at the Universidad de Chile, was the course lecturer. In the first part, the course addressed the basic requirements for genetic improvement programmes and the inclusion of disease resistance parameters, the use and application of molecular markers (microsatellites, SNPs), techniques for genotyping, high- and low-density SNP chips, and for sequencing (next-generation sequencing [NGS], Rad-sequencing Nanopore) and the theoretical basis of genome-wide association analysis (GWAS) and statistical methods. Additionally, the example of genetic resistance to IPNV in Atlantic salmon was given, which led to a decrease in disease outbreaks in this species through the application of disease-specific molecular markers. Later, during the in-person phase, practical work was dedicated to the R language, quality control of genomic data with PLINK software, genomic selection and genotype imputation using various software for estimating and predicting genomic values, and finally the application of GWAS and search for markers associated with disease resistance. There was also a guided tour to the genetic laboratories and facilities for experiments with trout disease resistance.

The IAEA acknowledges the support of Dr. José Manuel Yañez, Project Coordinator, and Dr. David Tapia for the strong support in the implementation of the event.

Training Course on Detection and Differential Diagnosis of Peste des Petits Ruminants in Small Ruminants and Other Non-Conventional Hosts

Charles Lamien and Giovanni Cattoli

The training course was held from 17 to 28 October 2022 at the IAEA Laboratories in Seibersdorf, Austria.

The aim was to provide basic knowledge on next-generation sequencing (NGS) and NGS data analysis on the Linux interface. In addition, the participants received training on advanced concepts of the phylogenetic analysis of viruses.

The purpose of the event was to strengthen the VETLAB partner laboratories' capacities for diagnosing and monitoring Peste des Petits Ruminants (PPR) and other respiratory diseases in small ruminants and other non-conventional hosts, in line with the implementation of the PPR GEP (Peste des Petits Ruminant Global Eradication Programme). This training course allowed the participants to improve their knowledge of diagnostics tests used for PPR and respiratory diseases and informed them on how to apply the acquire knowledge to their local situation and needs. The training covered the diagnostics in the first week and epidemiology, including the targeted pathogens' molecular epidemiology in the second week. Twenty-nine scientists from VETLAB partner laboratories in Asia and Africa participated in this course. The lecturers were from CIRAD (France), the Royal Veterinary College (UK), the PPR GEP secretariat (Italy), and the Joint FAO/IAEA Centre.

National Training Course on Brucellosis, Clostridial Infections/Intoxications and Selected Parasitic Diseases held in Gjirocaster, Albania (ALB5008)

Ivancho Naletoski

A national training course on brucellosis, clostridial infections/intoxications and selected parasitic diseases was organized from 21 to 25 November 2022 in Gjirocaster, Albania. The course included theoretical lectures and practical classes on the above-mentioned diseases. Twenty-two participants from the central reference laboratory (4 participants), regional laboratories (9 participants) and the regional veterinary inspection services (9 participants) attended the course. Four experts from the French National Agency for Food Safety, Environment and Work (ANSES) (brucellosis), University of California, Davis; School of Veterinary Medicine (clostridial infections / intoxications) and the Croatian veterinary institute (parasitic diseases) have supported the theoretical and practical programme.

The expert Dr. Relja Beck demonstrates techniques for detection of parasitic diseases at the national training in Gjirocaster, Albania, organized under the ALB5008 project

Visit to the Counterpart Laboratories of the Food Safety and Veterinary Institute in Tirana, Albania (ALB5008)

Ivancho Naletoski

Due to global warming, increased global travel and trade and increased migration/trade in live farm animals, the risk of transmission of vector borne diseases in Albania has significantly increased. Especially the movement of animals from "tick-free" to "tick-endemic" areas has increased the risk of tick-borne diseases. To address this, officially designated laboratories in the country need systems for monitoring the biology and epidemiology of endemic ticks, technologies for detection and characterization of tick-borne pathogens as well as staff trained to perform these technologies on daily basis. Even more important for the veterinary authorities in Albania is the integration of these technologies into the overall disease monitoring and control plans.

The project ALB5008 delivered a series of fellowship trainings for the staff of the counterparts' laboratory, an extensive package of equipment and consumables, and a series of activities to facilitate the integration of the implemented technologies in national disease monitoring and control plans. Among the last are the two master's degree students at a One Health programme, supported by the project.

The technical officer and the programme management officer of the project visited the laboratories of the Food Safety and Veterinary Institute, the Faculty of Veterinary Medicine, Head of Veterinary Sector, and the General Director of the National Food Authority, as well as the FAO representative in Albania, from 26 June to 1 July 2022. The discussions focused on: (i) rapid and efficient implementation of detection and characterization technologies in the local laboratories (in accordance with the international standards); (ii) harmonization of the diagnostic procedures among the sub-national (regional) laboratories; (iii) integration of the delivered technologies in the disease monitoring plans, and (iv) the establishment of sustainable connectivity between the designated laboratories and the national veterinary education system (hands-on/know how learning integrated in the education process of the students at the faculty of veterinary medicine).

Regional Training Course on Detection and Characterization of Capripox and Peste des Petits Ruminants Viruses (RER5027)

Ivancho Naletoski

A regional training course on detection and characterization of capripox, lumpy skin disease (LSD), sheep and goat pox (SGP), and peste des petits ruminants (PPR) viruses was organized at the Croatian Veterinary Institute in Zagreb, Croatia from 10 to16 June 2022. The course included theoretical lectures and practical exercises for serological and molecular detection of the diseases [(i) ELISA for the detection of antibodies against capripoxviruses (ID-Vet ID Screen Capripox Double Antigen Multi-species); (ii) real-time PCR for detection of capripox viruses; (iii)identification of capripox virus by pancapripox / IC / EC RT-qPCR; (iv) Real-Time PCR for capripox virus detection – CPV-Diva, LSDV-Diva; (v) ID-Screen® PPR Competition ELISA (PPR Antibody ELISA); (vi) real-time RT-PCR for Detection of Peste des Petit Ruminants virus (PPRV); (vii) one-step real-time RT-PCR for diagnosis of PPRV; (viii) conventional RT-PCR for detection of PPRV (N gene)]. All the above-mentioned procedures were

uploaded onto the iVetNet Information Platform and made available to the wider counterpart community.

Participants were informed about the possibility to use the Animal Production and Health sequencing service for characterization of detected LSD, SGP and PPR viruses.

Nineteen participants from 18 Member States participated in the course (Albania, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Georgia, Greece, Hungary, Latvia, Lithuania, Malta, Montenegro, North Macedonia, Portugal, Romania, Russian Federation, Serbia, Slovakia, Türkiye). The course was supported by 7 international experts from the Pirbright Institute, United Kingdom (2 experts), Sciensano, Belgium (3 experts), FAO (1 expert) and CIRAD, France (1 expert).

Participants at the regional training course on detection and characterization of LSD, SGP and PPR during the practical exercises in the laboratories of the Croatian veterinary Institute

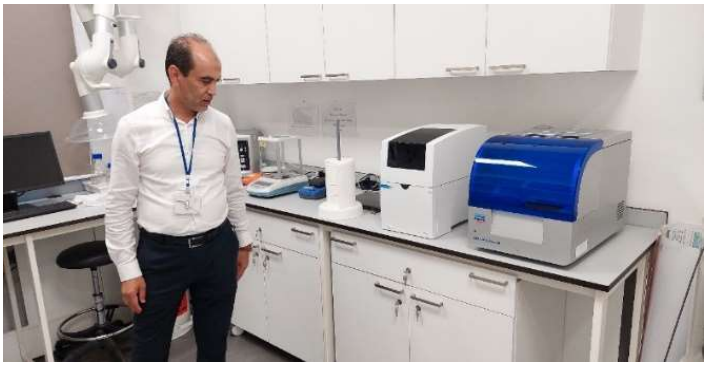
Visit to the Counterpart Laboratories at the National Center for Scientific and Technical Research (CNRST) in Rabat, Morocco (MOR5039)

Ivancho Naletoski

The project MOR5039 aims to integrate genomics in human health, nutrition and proteomics based on the use of stable isotopes, and improve the diagnosis of viral infections, tracking of outbreaks, and identification of antimicrobial resistance. The integrative approach is based on national infrastructures with cutting–edge technologies for genomic and proteomic studies and facilitate a national scientific network.

The project targets to establish (or upgrade) technologies for genetic characterization and the mechanisms for development of anti-microbial resistance in animal and zoonotic pathogens. Additionally, the project aims to integrate multiple institutions from the relevant scientific fields (veterinary and medical professionals, environmental and climate specialists etc.) in a one-health consortium to strengthen the preventive and response system in the country.

During the period from 5 to 9 September 2022, the technical officer of the project visited the counterparts' laboratories in Morocco. A series of meetings were organized with the upper management of the National Center for Scientific and Technical Research (CNRST), the Institute for National Hygiene, Mohamed V Military Hospital, National Office of Sanitary Safety of Food Products (ONSSA), all in Rabat, and the Pasteur Institute of Morocco in Casablanca to discuss the above-mentioned topics, as well as future activities under the project.



The main counterpart of the project MOR5039, Dr. Elmostafa El Fahime demonstrating the current laboratory settings at the CNRST in Rabat, Morocco

First Research Coordination Meeting on Application of Advanced Molecular Characterization Technologies Through the Veterinary Diagnostic Laboratory Network (VETLAB Network) (D32036)

Ivancho Naletoski

A new Coordinated Research Project (CRP) was recently approved for implementation aimed to support the VETLAB Network laboratories with access to service based whole genome sequencing (WGS). The CRP is mainly focused on the establishment of a standardized workflow for sample preparation, quality control, shipment, data exchange and bio-informatic processing of the obtained WGS data.

The first RCM took place from 12 to 16 December 2022. Four agreement holders (Australia, Hong Kong, China, United Kingdom and United States of America), three technical partners (Austria, Belgium and Germany) and eight research partners (Argentina, Croatia, Indonesia, Morocco, Mozambique, Namibia, Senegal and Serbia) attended the meeting.

The meeting focussed on defining the critical steps of the process and the procedures needed for development of the service based WGS workflow. It is expected that at the end of the project, APH will have a standardized and proven process, similar to the existing one for access to Sanger sequencing, to enable the wider counterpart community rapid access to next- generation sequencing (NGS) and data evaluation. The workflow is planned as a cost-free service for the VETLAB Network laboratories.

Regional Training Course on Next-Generation Sequencing (NGS) using the Illumina Platform (RER5027)

Ivancho Naletoski

The regional training course on next-generation sequencing (NGS) using the Illumina Platform was organized at the facilities of the ELIXIR Centre of the University of Ljubljana in Maribor, Slovenia. The course included theoretical lectures and practical exercises on the required workflow for performing NGS - sample preparation and inactivation: (i) host nucleic acids (NA) removal; (ii) extraction of NAs; (iii) biological safety of extracted NAs for international; (iv) use / benefit of specific procedures (RNA based capture, SISPA etc.); (v) PCR amplification-based procedures for specific pathogen (influenza A virus and Newcastle disease were used as a model) and the use of the Illumina hardware. Special emphasize was given to the bio-informatic processing of the obtained raw data using the (currently) most used software platforms – Linux and Galaxy.

Sixteen participants attended the course, one from each of the counterpart laboratories (Albania, Azerbaijan, Bosnia and Herzegovina, Croatia, Cyprus, Georgia, Greece, Latvia, Lithuania, Montenegro, Portugal, Romania, Serbia, Slovakia, Türkiye and Uzbekistan). The course was supported by 3 international experts – Sciensano, Belgium (1 expert), University of Freiburg, Germany (1 expert) and University of Glasgow, Centre for Virus Research (1 expert).

Participants of the regional training course on NGS using the Illumina Platform during the practical exercises at the laboratories of ELIXIR, Maribor, Slovenia

Group Fellowship Training on the Next-Generation Sequencing (NGS) at the Animal Production and Health Laboratory in Seibersdorf (INT5157 Pillar 1 of the ZODIAC Initiative)

Ivancho Naletoski and Charles Lamien

During the first phase of support to the Zodiac National Laboratories (ZNLs), five laboratories were selected as technical hubs to implement and further disseminate the NGS technologies in their appropriate regions. Three of the five recipient ZNLs expressed interest in using the Ion Torrent S5 platform (Indonesia, Senegal, and Tunisia). From 9 May to 1 August 2022, the selected candidates from the three countries received hands-on training in NGS using the Ion Torrent S5 platform. The training focused on the priority diseases of the selected countries and regions and the use of the platform for metagenomic analysis to enable the users' non-targeted (random) identification of pathogens of interest present in the samples. Follow-up group fellowships are planned in the first half of 2023 to train the staff from the same laboratories in bioinformatic data analysis and interpretation of the results.

The fellows from the group fellowship training on the next-generation sequencing (NGS) at the Animal Production and Health Laboratory in Seibersdorf

Stories

Towards Increasing Milk and Meat Production in Togo (TOG5003)

Victor Tsuma

In Togo, like many developing countries, livestock are fundamental for sustainable development. They provide much needed nutrients for healthy households as well as income from sale of animals and animal products to support other key livelihood needs. However, productivity, especially of cattle is low, with a huge but yet to be optimised potential. Farmers rely on local indigenous breeds that take long to mature and produce very little meat and milk. To meet the increasing demand for foods of animal origin in Togo there is need to avail and efficiently deliver affordable improved cattle genotypes to farmers. Frequently cited cattle production constraints include breeding and availability of superior genotypes. Artificial insemination (AI) is an efficient, cost-effective reproductive technology for dissemination of desired germplasm, that has over the years extensively transformed cattle herds across the world.

Fig 1. *Brunes des Alpes local cow crossbreed calf with its dam (L) and Montbeliarde local cattle crossbred calves (Middle and R)*

Through support from the IAEA, Togo has been able to acquire improved cattle genetics and efficiently breed local cattle for delivery of superior genotypes to farmers. Recently 52 cattle inseminations were carried out, achieving a first service conception rate of 61.5%. In the month of October 2022, six calves (3 female and male each) were born at Avetonou Research Centre (Fig. 1.). The animal genetics laboratory supported by the IAEA will enable genetic characterisation of the calves for informed rapid selection for breeding; the established bull centre and semen laboratory will enable production, processing, preservation and availability of the desired genotypes; the established progesterone radioimmunoassay laboratory, operationalisation of AI services and human capacity development in AI will enhance efficient delivery and outcome of AI services to disseminate appropriate breeds to farmers. This support will assist Togo meet its food security needs and improve the livelihoods of the population through provision of household meat and milk products and income from sale of animals and animal products.

Cameroon's Veterinary Authorities Fight Off Ruminant Disease Using Nuclear Derived Techniques

Peste de petits ruminants (PPR). PPR is endemic in Africa– its spread is facilitated by the movement of wild animals as well as domesticated herds across borders – and despite earlier control campaigns it has returned to Cameroon, affecting the north and the far north of the country, which is home to 80% of Cameroon's livestock, as indicated by Gabriel Toumba, Regional Coordinator of the Livestock Development Project, a World Bank supported programme that coordinated the vaccination campaign on the ground. Nearly 90% of small ruminants were vaccinated in each of the three years of the campaign, using vaccines produced by the National Veterinary Laboratory (LANAVET). LANAVET produces 25 million doses of vaccines each year to fight various veterinary diseases infecting cattle, small ruminants and poultry. It performs the diagnosis and quality controls through the application of nuclear and related technologies. Around half its equipment has been donated by the IAEA through its technical cooperation programme and the VETLAB Network.

The longstanding support by the IAEA has provided training and expert advice, as well as reagents and consumables to LANAVET to carry outs its research and quality control work, said Simon Dickmu Jumbo, Director of the national laboratory's Animal Diagnosis Department. This skills development, complemented by regular advice from the IAEA has led to the successful accreditation of the lab as ISO 17025-compliant. It's been able to increase its capacity as a result, and now supports several countries in the region by exporting seven different veterinary vaccines.

It was the diagnosis by LANAVET experts back in 2019 that confirmed the epidemic: 44% of animals surveyed were found to be infected. After the campaign that led to the vaccination of around 5 million small ruminants nationwide, less than 5% in the surveyed sample fell sick, and the ratio keeps falling, Jumbo said. "This is the proof that LANAVET met the main objective of the project with the IAEA: to help alleviate poverty among small-scale farmers through the control of PPR by supporting the national vaccination programme and informing the country's vaccination strategy," Jumbo said.

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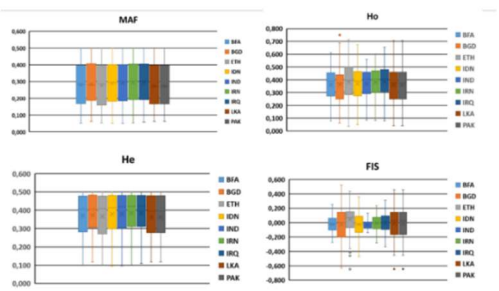
Research Activities of the Animal Production and Health Laboratory

Animal Genetics

Testing Commercial Sheep SNP Array for Genomic Evaluation of Indigenous Asian and African Sheep Breeds

The Animal Production and Health Laboratory (APHL) initiated the testing of commercial sheep SNP array to estimate the level of ascertainment bias and assess their suitability for genomic evaluation of indigenous Asia and African sheep breeds. A total of 643 sheep belonging to 28 indigenous breeds located in 13 countries (Austria, Argentina, Bangladesh, Bulgaria, Burkina Faso, Ethiopia, Indonesia, India, Iran, Iraq, Sri Lanka, Pakistan and Uruguay) were genotyped on Affymetrix-Axiom-Ovine Genotyping array. The results revealed more than 41 000 polymorphic markers in indigenous sheep with overall mean MAF, observed heterozygosity, expected heterozygosity and inbreeding coefficient estimated to be 0.281, 0.371, 0.375 and -0.010 respectively.

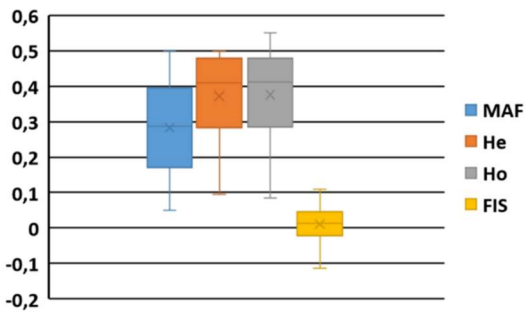
The observed heterozygosity varied between 0.361 (Sri Lankan and Pakistani sheep) and 0.386 (Iraqi sheep) while expected heterozygosity ranged from 0.362 (Sri Lankan and Pakistani sheep) and 0.386 (Iraqi sheep). The overall diversity observed in Asian and African sheep was moderate. Sub-population bias can inflate the heterozygosity estimates in populations closely related to the SNP discovery panel while it can underestimate the diversity in populations distantly related to the SNP discovery panel. It may also increase or decrease the estimates of F_{ST} as compared to the expected estimates from unbiased data, thus obscuring information on population differentiation. Genotyping of additional Asian, African and European sheep breeds is currently under progress to assess the ascertainment bias, genomic diversity and population structure.



Genomic diversity of indigenous Asian and African sheep populations

Genomic Evaluation of Graded Kenyan Holstein Cattle to Assess Diversity and Admixture

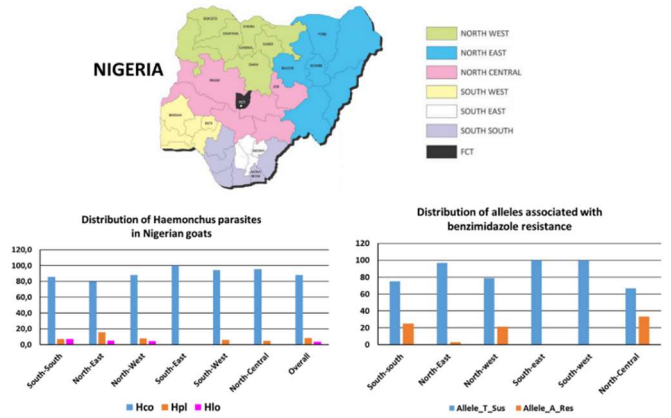
Dairy cattle improvement in Kenya is mainly implemented by grading up local cattle with commercial Holsteins for increased milk productivity. In high external input dairy production systems of Kenya, graded up cattle with high level of taurine inheritance are commonly raised. However, the level of genetic admixture in these cattle is often unknown. The CRP research contract on "Use of genomic tools to evaluate and select animals for artificial insemination programs for sustainable dairy cattle productivity in Kenya" aimed (i) to determine the level of taurine admixture among graded up Kenyan Holstein cattle using genome-wide SNP data and (ii) perform genomic evaluations of sires and compare with conventional breeding value estimations. Pedigree and performance data were recorded from 600 cows targeting information on age, body condition score (BCS), parity, calving date, age at first calving, milk yield, service dates, services per conception and calving interval. Animal Production and Health Laboratory provided technical and scientific support to the project team for performing genome wide analysis and estimation of genetic admixture in graded up Holstein cattle. A total of 384 cattle were genotyped using 60K bovine SNP array. Preliminary analysis was conducted to assess genomic diversity parameters including observed heterozygosity, expected heterozygosity and inbreeding estimates. The results revealed a mean observed heterozygosity of 0.376±0.001 and mean expected heterozygosity of 0.371±0.001. The inbreeding estimate for the Kenyan Holstein population was low with a mean value of 1.1%. Genotyping indigenous Boran cattle and estimation of conventional breeding values for production traits is currently under progress.



Genomic diversity of graded up Kenyan Holstein cattle

Molecular Characterization and Assessment of Anthelmintic Resistance in *Haemonchus* Isolates from Nigerian Goats

Hameonchus is one of the important gastro-intestinal nematode parasites affecting goat production in Nigeria. At least, three major sympatric species of *Haemonchus*, *H. contortus, H. placei* and *H. longistipes* are commonly observed in infected goats. Differences in the epidemiological distribution of these species/variants exist in different regions of the country. The level of anthelminthic resistance differs among various species/variants and the fact that the process of genetic recombination among the parasites transfers anthelminthic resistance to susceptible worms further adds complexity to the problem. Hence, the correct identification of various species/variants, information on epidemiology, genetic characteristics and anthelmintic resistance of the principal circulating species/variant is essential for establishing sustainable control strategies. Animal Production and Health Laboratory (APHL) provided technical and scientific support to National Animal Production Research Institute, Ahmadu Bello University Zaria, Nigeria to implement a project on molecular characterization and assessment of anthelmintic resistance in *Haemonchus* isolates from Nigerian goats. More than 200 *Haemonchus* isolates collected from six different regions (South-South, North-East, North-West, South-East, South-West and North-Central) were analyzed. The snapback primer probe assay developed by APHL earlier was used to detect and discriminate sympatric *Haemonchus* species. Overall, 88.1% of the isolates were *H. contortus*, 8.3% belonged to *H. placei* and 3.6% belonged to *H. longistipes*. Regional differences were observed in the distribution of sympatric species with the prevalence of up to 15.4% *H. placei* in North-East Nigerian isolates while *H. contortus* being the only observed species in South-East Nigerian isolates.

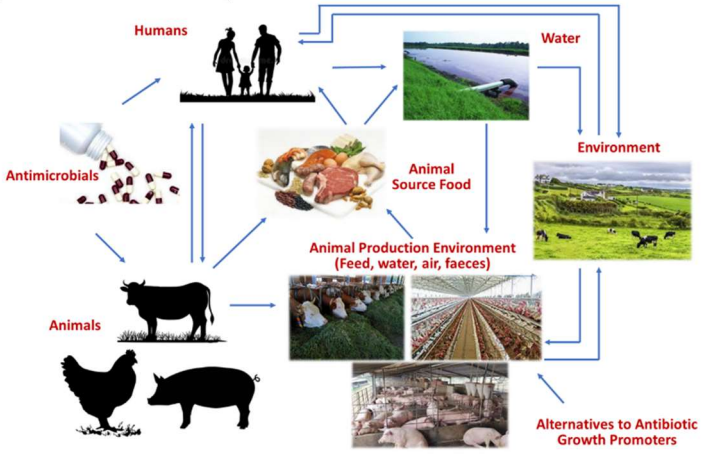


Species distribution and alleles associated with anthelmintic resistance in Haemonchus isolates from Nigerian goats

Targeted sequencing of mitochondrial cytochrome oxidase subunit 1 (COI) and beta tubulin isotype 1 genes was also performed to assess the molecular epidemiology and anthelmintic resistance in Nigerian *Haemonchus* isolates. The preliminary results revealed the frequency of alleles associated with benzimidazole resistance was high in *Haemonchus* isolates from North-Central region while it was lowest in South-East and South-West regions. Further analysis of molecular epidemiology data is in progress.

Coordinated Research Project (D30003) on Alternative Approaches to Detect and Characterize AMR in Animal and Animal Production Environment

Antimicrobial resistance (AMR) is an issue of global public health concern causing more than 1.2 million deaths in 2019 and is considered as a pandemic in silence. Misuse and overuse of antimicrobials in humans, animals, and crop production are the main drivers in the development of drug-resistant micro-organisms. A major portion of global antibiotic production is destined for use in animals for treatment, disease prevention and growth promotion. The spread of AMR microorganisms and their genes in the animal production environment is one of the important public health threats. Tackling the threat of AMR requires a "One Health" approach involving animal, animal production environment (feed, faeces, water, air), human and other environmental factors. In the framework of the Quadripartite initiative (WHO, WOAH, UNEP and FAO) on AMR, Animal Production and Health section is collaborating with FAO to support the implementation of FAOs' Action Plan on AMR 2021-2025. As part of this collaboration, Animal Production and Health Laboratory launched a Coordinated Research Project to strengthen research on AMR surveillance and promote good husbandry practices in animal production environments.



AMR transmission and mitigation at Animal-Human interface

This CRP aims to develop alternative approaches to assess the occurrence and transmission routes of AMR in different animal production systems (e.g. high and low input systems) with a focus on bioaerosol, water, feed and faecal

routes using nuclear, microbial and molecular technologies. The expected deliverables of the CRP are; (i) Optimized methods/protocols for sampling at farm level for detection of AMR in animal production environments; (ii) Distribution characteristics of Antibiotic Resistance Genes (ARGs) in high and low input animal production environments; (iii) Potential alternatives to antibiotic growth promoters in animal feeds; and (iv) Technical recommendations on good husbandry practices that helps reduce the risk of AMR transmission in animal farms.

Initially, Tianjin University from China and ICAR-Directorate of Poultry Research from India will be involved in characterizing AMR in animal production environments. The Tianjin University will focus on optimization and validation of sampling methods for AMR detection in bioaerosol in pig and poultry farms, identifying the potential environmental factors driving antibiotic resistance genes and their transmission in animal farms and estimating the level of antibiotic residues in chicken and pig production environments. The ICAR-Directorate of Poultry Research will assess the occurrence of ARGs in poultry production environments and evaluate potential efficacy of selected alternatives to antibiotic growth promoters (AGPs) as additives in poultry feed. More partners from other countries are expected to join the CRP in 2023 to work on AMR in dairy cattle production environments and application of stable isotope technologies in characterizing and linking AMR genotypes with their associated phenotypes.

Animal Health

Molecular Detection and Syndromic Surveillance of Zoonotic Diseases

Direct multiplex detection of zoonotic pathogens in birds

Birds, mainly migratory birds, contribute to the spread of pathogens into poultry farms and which can occasionally spill over to other animals, including humans. For instance, all flu-related pandemics are from an avian influenza virus origin, rendering birds a host of pathogens that significantly impact public health. Hence, practical, user-friendly, inexpensive tools are required to detect and identify zoonotic pathogens in birds rapidly. The Animal Production and Health Laboratory (APHL) is evaluating two multiplex PCR-based assays for detecting Flavivirus, Influenza A virus, and Paramyxovirus (NDV) in birds. The first assay involves a multiplex probe-based rt-PCR that enables the detection and identification of the three virus families since the probes are labelled with different fluorescent reporter dyes (Figure 1a). The second assay involves a multiplex RT-PCR for the detection of the three virus families, which show the expected PCR products; Flavivirus (204 bp), Influenza A virus (166 bp), and Paramyxovirus NDV (164 bp), followed by nanopore sequencing of the PCR product (Figure 1b). The application of nanopore sequencing technology using a portable MinION device confirms the detected virus families and can identify different species of viruses belonging to the same family. While further field evaluation is ongoing, these cost-effective, quick, and practical assays are expected to facilitate the surveillance and monitoring of zoonotic viruses in birds.

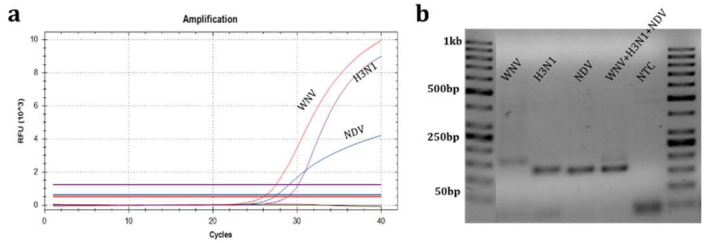


Figure 1. Multiplex PCR-based assays for the detection of Flavivirus, Influenza A virus, and Paramyxovirus (NDV) in birds. (a); detection and identification of WNV (Flavivirus), H3N1 (Influenza A virus), and NDV (Paramyxovirus) based on probes labelled with different fluorescent reporter dyes. (b); gel image showing the amplification pattern of WNV (204 bp; lane 1), H3N1 (166bp; lane 2), NDV (164bp; lane 3), and a mixed sample (representing co-infection) showing two products (~204 and 166 bp; lane 4) representing the presence of Flavivirus, Influenza A virus, and Paramyxovirus NDV, and no band on the negative control (NTC)

Comparison of a fourplex HRM and Taqman qPCR assays for the detection of Brucella spp. and Coxiella burnetii in ruminants' abortion cases

Brucella spp., *Coxiella burnetii*, *Leptospira* spp. and *Listeria monocytogenes* are zoonotic abortifacient agents. Because they can significantly impact both animal and public health, the Animal Production and Health Laboratory (APHL) in collaboration with BNVL have developed a rapid differential method for the diagnosis of abortions. Here we report on the comparative analysis of abortive samples suspected of *Brucella* spp., *Coxiella burnetii* using the newly developed fourplex HRM real-time PCR assay and probe-based qPCR assays for *Brucella* spp. and *Coxiella burnetii*. The analysis of hundred and fifty-two (152) clinical samples from cattle, sheep, and goat abortion cases in Botswana revealed the presence of *Brucella* spp. in 36 samples, *Coxiella burnetii* in 38 samples, co-infection with *Brucella* spp. and *Coxiella burnetii* in 58 samples, and 54 samples were negative. *Leptospira* spp. and *L. monocytogenes* were not detected.

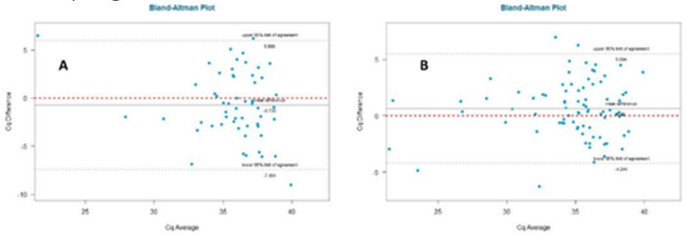


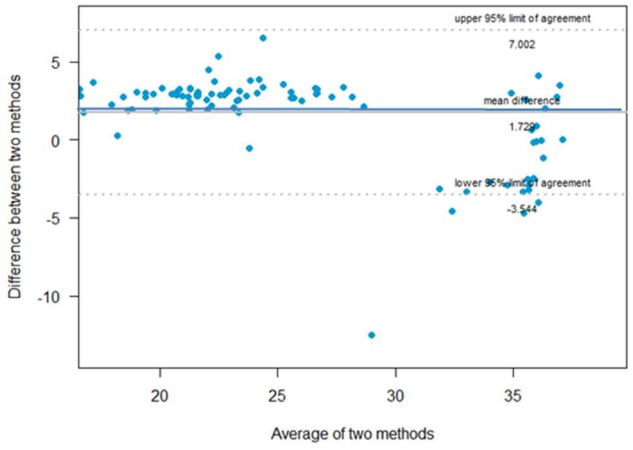
Figure 2. Bland-Altman analysis of HRM versus probe-based qPCRs (A: Brucella spp. qPCR; B: Coxiella burnetiid)

There was a perfect agreement between the fourplex qPCR-HRM assay, and each of *Brucella* spp. and *Coxiella burnetii* Taqman qPCR assays (kappa =1). Similarly, the Bland-

Altman analysis showed a mean Cq difference of -0.7 for HRM versus *Brucella spp.* qPCR and 0.63 for HRM versus *Coxiella burnetii* qPCR (Figure 2), suggesting a good agreement. The HRM fourplex assay is a valuable diagnostic tool to detect *Brucella* species and other infectious agents, with comparable results to existing Taqman assays at reduced cost.

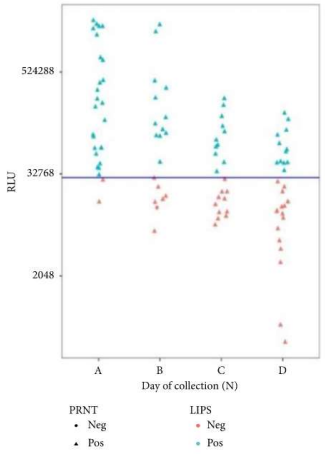
Comparative assessment of lyophilised and wet reagents for the molecular detection of avian influenza virus

Global surveillance for avian influenza virus (AIV) in birds is essential for assessing public and animal health risks and real-time polymerase chain reaction (RT-qPCR) is a recommended diagnostic method by the World Organisation for Animal Health (WOAH, 2021). Yet, in low-resource setting laboratories, the detection of AIV is hampered by the need to maintain a cold chain for *wet* reagents. In such cases, alternatives should be ready to maximize surveillance and mining of AIV. Therefore, in collaboration with the FAO Animal Production and Health DivisionQ and the FAO/OIE/EU Reference Laboratory for AI, we compared two lyophilized RT-qPCR reagents (1st - 5X CAPITAL™ 1-Step qRT-PCR Probe Reagent, lyophilized kit, and 2nd - Qscript lyo 1-step-kit) to the WOAH recommended protocol by Nagy et al., 2020 using QuantiTect Probe RT-PCR-kit as *wet* reagent. The comparative study panel comprised 102 RNA samples from two AIV subtypes. Despite the fact that the *wet* reagent exhibited the lowest limit of detection (LOD) compared to the two lyophilized reagents, the inter-assay agreement was substantial between the 1st lyophilized reagent and the comparator with 95.1% of shared positive results. Cohen's-kappa was fair between the 2nd lyophilized reagent and the comparator with 75.5% of shared positive results.



The Bland Altman plot shows differences between the Cq values of the comparator and the 5X CAPITAL™ 1-Step qRT-PCR Probe Reagent (lyophilized reagent) against the average Cq values (following the protocol by Nagy et al., 2020). The blue line represents the scenario of identity with a perfect agreement. The grey lines represent the bias between the test assays and the comparator. The grey dotted lines represent the limits (upper and lower) of agreements.

Agreement using the statistical test Bland-Altman was good for samples with Cq values < 25 for all reagents with diverging Cq values > 25, revealing discrepancies when the viral load is low. Results obtained were confirmed using the same lyophilized reagents but following the protocol by Heine et al. 2015 with AgPath-ID™ One-Step RT-PCR as a comparator, showing that Cq values increase using lyophilized reagents but correlate strongly with the *wet* reagent. This study provides data that enables laboratories to choose any of the tested reagents depending on their specific needs, requirements, and availability. A manuscript has been prepared on these findings.



Distribution of RLU values generated using the sera from naturally SARS-CoV-2-infected mink samples across LIPS-N assay with threshold line, identification of PRNT results, and sera sampling dates (A-D).

Research on Infectious Diseases of Swine

Pigs are among the most raised animals in the world. In many countries and cultures, they represent the primary protein source for millions of people. Although 50% of the global pig population is concentrated in China (followed by the EU and the U.S., FAO source), pig production is an important means of livelihood in many parts of Africa and Asia, particularly in rural communities relying on agriculture and livestock production. Indeed, in several developing countries pigs are increasingly perceived as a source of income generation and poverty reduction. In many African countries, most of the pigs are kept by smallholders in rural areas. However, intensive commercial pig production is becoming more popular in Africa because of the favourable return on investments. In Africa and Asia, pig diseases represent a major constraint to profitable production and have devastating impacts upon the industry leading to losses in hundreds of millions of dollars every year. For example, in Africa efficient and profitable pig production has been on the decline irrespective of the benefits derived from pig farming due to diseases such as African swine fever, FMD and parasites. Therefore, detection, prevention and control of swine infectious diseases is an animal health priority for developed and developing countries.

Culturing and quantification of porcine circovirus-2 (PCV2) to study host pathogen interactions and to produce a candidate irradiated vaccine

Porcine circovirus (PCV) is a common virus of pigs found throughout the world (see also PCV data from Africa in separate chapters of this newsletter). Two types of circoviruses in swine have been described. Type I (PCV1) may be involved in congenital tremors, but it is generally considered to be non-pathogenic for swine. Analysis has demonstrated that PCV associated with PCVAD in swine is distinctly different genetically and antigenically and it is now classified as PCV2.The emergence of PCV2 coincided with the occurrence of a new clinical syndrome of swine referred to as postweaning multisystemic wasting syndrome. PCV2 infection has been reported globally. Although vaccines (inactivated and subunit) are available against PCV2, and they have been able to reduce the clinical disease, subclinical PCV2 infection and emergence of new variants continue to remain a cause for concern. Therefore, we aim to develop a safe, irradiated vaccine prototype against PCV2.

As the first step in this research, an absolute quantification PCR method was established for PCV2. DNA was extracted from PCV2 positive clinical samples. Then target gene (the whole PCV2) was cloned, into the pGEM vector. The plasmid was sequenced and compared with the PCV2 sequence on NCBI. The target gene was confirmed to contain the full length of PCV2 and have 100% similarity with the primers and probe for absolute qPCR. Then the plasmid was used as the standard plasmid (Fig. 3.). Next, using PCV free PK-15 cells, the clinical samples were isolated by passaging, and viral proliferation was detected in two of the four samples during passaging by absolute quantification PCR and flow-cytometry methods (Fig. 3.).

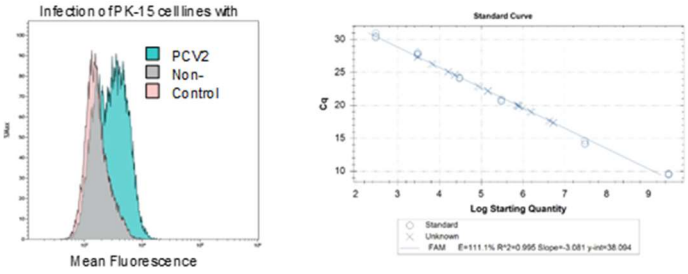


Figure 3. Left panel: PCV2 infection of PK-15 cell lines measured by flow cytometry. Infected or non-infected cells were stained with a monoclonal antibody against PCV2 specific capsid antibody while control staining was done with an iso-type control antibody. Right panel: Standard curve to determine the PCV2 load

In addition to the clinical disease induced by PCV2, the concurrent infection of PCV2 infected animals with African swine fever (ASF) virus, may have an impact on infection kinetics and disease outcomes, considering the immune suppression caused by PCV2. To investigate this phenomenon, we are conducting experiments on PCV2 virus and host interactions. We use monocyte derived dendritic cells (MoDC) from swine for these investigations. In our first experiment we evaluated the uptake of PCV2 virus by swine MoDC (Fig. 4.). Future experiments will be conducted to examine the fate of PCV2 and immune responses induced by MoDC when the PCV2 interact with MoDC.

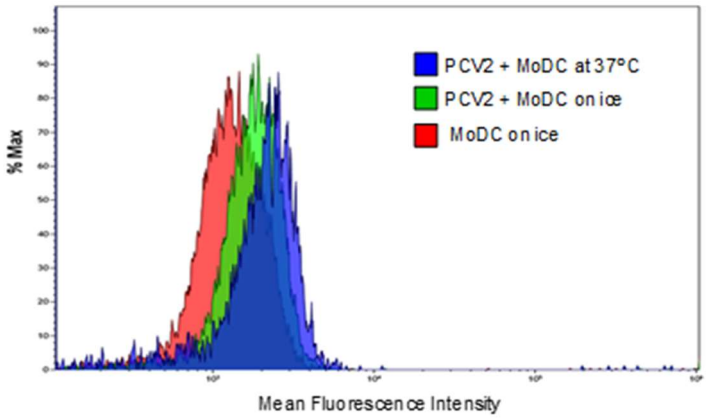


Figure 4. Swine MoDC were generated by adding GM-CSF and IL-4 to monocytes isolated from swine blood. Next MoDC were incubated for one hour with or without PCV2 at 37° C or on ice

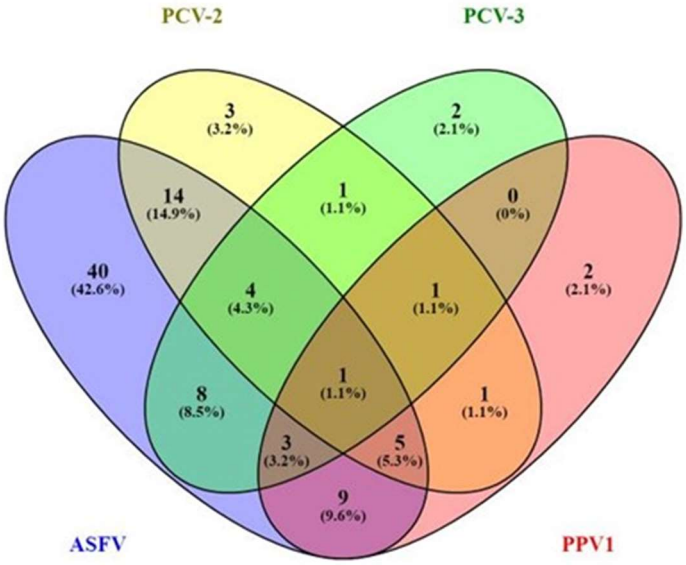
Molecular Characterization and Epidemiology

Viral Co-infections of warthogs in Namibia with African swine fever virus and Porcine Parvovirus 1

Understanding virus circulation in wild animals, particularly those that have contact with domestic animals, is crucial for disease management and control. In Africa, warthogs are known to be asymptomatic carriers of porcine pathogens; a recent study in Namibia has shown them to be positive for porcine circovirus-2 (PCV-2). In this study, the same samples used for the PCV-2 investigation in Namibia were further screened for the presence of African swine fever virus (ASFV) and porcine parvovirus 1 (PPV1) by PCR. Of the 42 animals tested, 2 (4.8%) and 13 (31%) were positive for AFSV and PPV1, respectively. The two AFSV were also co-infected with PPV1. Combing the results of this study with the results of the previous PCV-2 investigation, four warthogs were shown to be co-infected with both PPV1 and PCV-2. Sequence and phylogenetic analysis revealed that the AFSV belonged to genotype (Ib) but were from different serogroups. Unexpectedly, the ASFVs from the warthogs were genetically distinct to those observed in an outbreak in the same region of Namibia that occurred less than fifteen months prior to the sampling of the warthogs. In fact, a stronger genetic relationship was observed between the warthog viruses and historical Namibian and South African ASFVs identified in 1980, 2004 and 2008. For the PPV1s, the closest relative to the Namibian PPV1 were viruses identified in wild boar in Romania in 2011. This study confirms that warthogs are carriers of porcine pathogens and the data should encourage further studies on larger populations of wild and domestic swine to more fully understand the epidemiology and transmission of viral pathogens from these species.

Co-infections of African swine fever virus, porcine circovirus 2 and 3, and porcine parvovirus 1 in swine in Nigeria

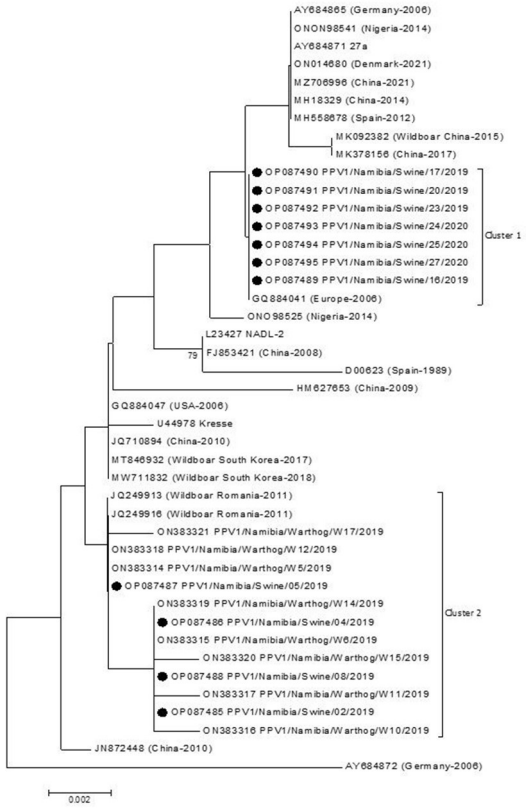
As pig production increases in Africa, it is essential to identify the pathogens that are circulating in the swine population to assess pig welfare and implement targeted control measures. For this reason, DNA samples collected from pigs in Nigeria in the context of African swine fever monitoring were further screened by PCR for porcine circovirus 2 (PCV-2), porcine circovirus 3 (PCV-3), and porcine parvovirus 1 (PPV1). Forty-seven (45%) pigs were positive for two or more pathogens. Sequence analysis identified PCV-2 genotypes a, b, and d, while limited genetic heterogenicity was observed among PCV-3 strains. All except one of the PPV1 sequences were genetically distinct from those previously identified in other countries.



Venn diagram showing the number (and percentage) of viral infections/co-infections identified in this study

Evidence indicating transmission of porcine parvovirus 1 between warthogs and domestic pigs in Namibia

Thirty swine samples collected from different regions of Namibia between 2019 and 2020 were screened for the presence of porcine parvovirus 1 (PPV1) by PCR. Eleven samples (37%) were positive. Phylogenetic analysis of a partial sequence of the structural protein gene (VP2) identified two distinct clusters, one which contained sequences that were highly similar to PPV1 previously identified in warthogs in Namibia. These results indicate possible PPV1 transmission between warthogs and domestic pigs and highlight the importance of wildlife as sources of pathogens.



Maximum likelihood (ML) phylogenetic tree reconstructed based on partial PPV1 VP2 sequences (683 bp). Bootstrap values >70% are shown. Sequences obtained in the present study have been highlighted with black dots.

Irradiated Vaccines

Research article collection on irradiation technologies for vaccine development

Animal Production and Health Laboratory (APHL) together with the research community working on developing vaccines using irradiation technologies authored a research article collection at the high-impact journal "Frontiers in Immunology" https://www.frontiersin.org/research-topics/19316/irradiation-technologies-for-vaccine-development#articles. This open-access collection includes 15 research articles contributed by 101 authors from various laboratories around the world. APHL took the lead and contributed 7 of these. This research collection highlights some of the latest developments, innovations and understanding of the use of irradiation technologies for vaccine development. It also opened scientific and technical questions that need to be answered in future research, including the underlying mechanisms involved in the remaining metabolic activity in lethally irradiated microbial cells, generation of better cell mediated immunity compared to chemical inactivation, use of LEEI in bulk vaccine preparations, the best route to deliver irradiated vaccines, discovery of novel radio-protectant compounds to preserve vaccine antigenicity and stabilization of irradiated vaccine formulations.

Kinetic analysis of invitro immune stimulation of porcine PBMCs with irradiated Lactobacillus acidophilus

Probiotics have been known for their capacity of inducing health beneficial effects upon administration to host organisms. Among these beneficial effects, one of particular interest and relevance is their ability to modulate the immune system. The type of immune modulation they can exert can be pro-inflammatory (e.g. Th1, Th17), anti-inflammatory or regulatory (e.g. Th2), or mixed, depending on different factors such as strain selected, time and duration of administration, administered dose, route of administration, and so on. This diverse immune stimulation capacity represents an extremely interesting characteristic with a great potential, especially in the field of vaccine research and development. In fact, often inactivated vaccines are sub-optimal and they necessitate additional compounds to enhance their immune stimulation capacity, triggering a stronger and better immune response by the host, allowing to mount an effective protection against the pathogen targeted by the vaccine. This type of compound is known as adjuvant, and this diversity of immune modulation capacity among different strains of probiotics offers a broad range of selection based on the type of immune modulation (proinflammatory, anti-inflammatory, regulatory or mixed) required for a particular prototype vaccine. However, one main concern about probiotics administration regards safety, since in previous studies their application has been correlated with horizontal gene transfer linked to anti-microbial resistance, or septicaemia in vulnerable individuals.

To study more in depth the great potential behind the application of probiotics as vaccine adjuvant, addressing at the same time the safety issue previously mentioned, at the Animal Production and Health Laboratory (APHL) we have been investigating lactobacilli which were made unable to replicate while preserving metabolical activity through gamma-irradiation. We first investigated the effect of gamma irradiation on the metabolism (evaluating the effect on ATP production, redox potential and membrane permeability), and then on the *in vitro* immune modulation exerted on swine peripheral blood mononuclear cells (PBMCs), measuring gene expression of a set of 26 immune markers, after 16 hours of stimulation (https://www.frontiersin.org/articles/10.3389/fvets.2022.859124/full).

These experiments allowed us to compare four different strains of lactobacilli (*Lacticaseibacillus casei, Lactobacillus acidophilus, Lactiplantibacillus plantarum,* and *Lacticaseibacillus paracasei*), two different treatments/manipulations (heat-inactivation and gamma-irradiation) with the live versions of these lactic acid bacteria (LAB), in one single time point (16h stimulation). From the first study, the main outcome was that gamma-irradiated *L. acidophilus* and *Lc. paracasei* showed an intact metabolism and a higher degree of similarity to their live state in terms of immune stimulation, compared to the other two strains evaluated, identifying these two strains as the ones to investigate further on. In fact, once assessed which strains were not only safe to administer but also able to maintain the immunomodulatory capacity (showing a high similarity with their live state), the second question we aimed to answer was on the time and duration of administration, as is well-known that cytokines' expression is a dynamic process, thus expecting gene expression levels to change (in terms of upregulation, downregulation or no change) at different time points. Therefore, the second step of this study was to evaluate gene expression levels at three different time points (3h, 16h and 48h) of stimulation using one of the two gamma-irradiated lactobacilli strains identified during the first part. The first strain chosen to be tested for this purpose was *L. acidophilus* and two analyses were performed, one to confirm what was previously highlighted during the first study (immune stimulating capacities preserved after irradiation) and another one to see if there are differences in the gene expression levels in the three different time points chosen (3h,16h and 48h). Preliminary results confirmed that there are no significant differences in gene expression levels among the different immune markers evaluated except for FOXP3 (which was not included in the set of cytokines used in the first study), as can be seen in Fig.5.

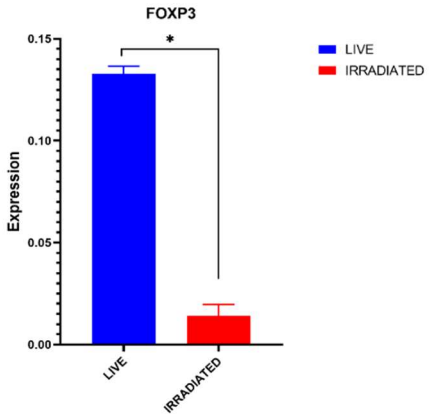


Figure 5. Significant difference ($p<0.05$) on FOXP3 gene expression levels comparing a 16h stimulation with live and irradiated L.acidophilus

The second analysis evaluated through a kinetic approach the gene expression levels difference stimulating PBMCs with gamma-irradiated *L. acidophilus* after 3h, 16h and 48h. Significant differences were found in IL-1b (Fig.6a) and TLR2 (Fig.6b) levels, indicating that the pro-inflammatory cytokine (IL-1b) and the toll-like receptor (TLR2) regulate their expression differently within a 48h time window.
Future experiments will be directed in analysing more samples to enhance and strengthen findings and knowledge regarding gamma-irradiated LAB.

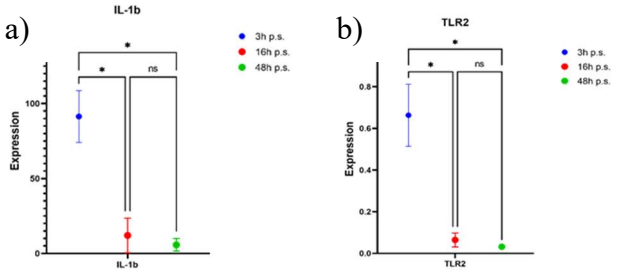
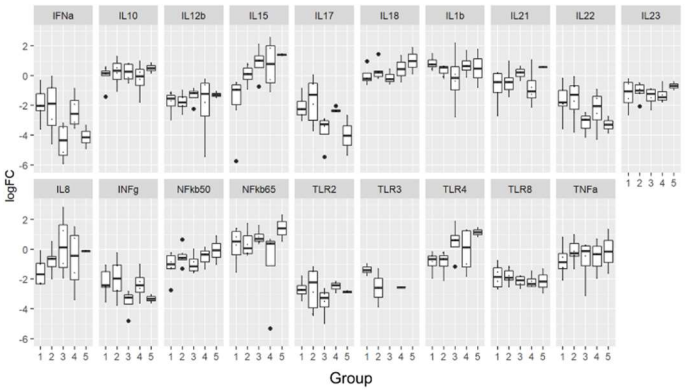


Figure 6. Significant difference (p<0.05) on a) IL-1b and b) TLR-2 gene expression levels comparing 3 different stimulation times (3h, 16h, 48h post stimulation) with irradiated L.acidophilus

Development of analytical tools in R for irradiated vaccine data obtained using qPCR

Measuring immune responses is a key step in evaluating the immunogenicity and efficacy of potential vaccines during their development and in accessing batch vaccine quality during their production. In order to assist in the various irradiated vaccine research projects at the Animal Production and Health Laboratory (APHL), experimental protocols that measure the expression of immune markers *in vivo* during animal trials and *in vitro* when carrying out cell-based assays from avian, ruminant, and porcine samples were undertaken at Seibersdorf laboratories. All three panels measure cytokine expression by qPCR and have been utilised in several studies various hosts involving several pathogens: chicken (avian influenza H9N2 and *E. coli*), pigs (African swine fever, porcine reproductive and respiratory syndrome and lactobacillus), cattle (lumpy skin disease), sheep (sheeppox virus) and goats (*Haemonchus contortus*). Various interleukin targets including cytokines, pathogen pattern receptors, cell surface markers and five different calibrator genes have been selected from previous reports and optimised using cells from various tissues such as PBMCs (blood), lymph nodes and tonsils in mammals, plus the harderian gland and spleenocytes in chicken. The range of confirmed interleukin targets ranges from 20 in ruminants to 26 in pigs and 32 in chicken (https://doi.org/10.1016/j.vetimm.2020.110092, https://doi.org/10.3389/fvets.2022.859124). RNA subsequently extracted from different cells either directly after immunisation *in vivo* or after various *in vitro* antigen and adjuvant experiments was used in standardised qPCR assays with SYBR green that measures the level of targeted interleukins. The conditions for PCR cycling in mammals was developed in house and adapted for Avian cells from previous work (https://doi.org/10.1016/j.molimm.2009.01.025). The Cq values obtained from cycling were used to calculate interleukin fold changes using untreated samples as controls and melt curves used to verify discreet targets where each interleukin has specific melt curve characteristics in different animals. Fold change values can then be used for analysis in R (statistical software) according to group and statistics generated alongside facetted boxplots to visualise individual interleukin expression between groups. Regression analysis modelling was also developed to predict interleukin expression in vaccinated versus non vaccinated animals.



Irradiated H. contortus study R analysis from 24 goat lymph node samples in five treatment groups. Groups 1-5; vaccinated and challenged day 70, only challenged day 70, vaccinated once day 35, vaccinated twice day 49 and vaccinated twice day 70 respectively.

Serological Surveillance of Zoonosis and Transboundary animal diseases

The luciferase immunoprecipitation system (LIPS) targeting the spike protein of SARS-CoV-2 is more accurate than nucleoprotein-based LIPS and commercially available ELISAs for mink serology

Since anthropo-zoonotic outbreaks of SARS-CoV-2 have been reported in mink farms, it is important to monitor the seroprevalence within this population. To investigate the accuracy of Nucleo (N) or Spike (S) protein-based assays to detect anti- SARS-CoV-2 antibodies in animal serum, in collaboration with the FAO Reference Centre for Zoonotic Coronaviruses (Italy) we compared four assays, two commercial N-based enzyme-linked immunosorbent assays (ELISA) validated for animal sera and two luciferase immunoprecipitation systems (LIPS-N, LIPS-S), to the reference standard Plaque Reduction Neutralization Test (PRNT). Samples included in this study derived from a naturally infected mink population. For the first time in this study, serum samples of mink were collected over a 307-day period, at different time points, thus providing an overview of performances of four different rapid serological tests over time. The assays were compared by performing a correlation analysis using R2, Spearman rank-order-correlation coefficient, Fleiss' and Cohen's kappa for analysis of agreement to PRNT and an UpSet chart was created to visualize the number of shared positive samples between assays. Cohen's kappa test on categorical data showed an excellent agreement between PRNT and LIPS-S, while agreements between PRNT and N-based methods decreased from fair for LIPS-N to poor agreements for the ELISA kits. In addition, LIPS-S revealed the highest number of true positive SARS-CoV-2 samples compared to N-based methods. Despite an excellent agreement between LIPS-S and PRNT, a weak correlation was detectable

between PRNT-titres and relative light units. This study shows that the LIPS-S assay can be used for serological surveillance within a naturally exposed mink population, while N-based serological assays are less accurate providing higher number of false negative results, especially at a later stage of infection, thus indicating that N antibodies are less persistent in naturally exposed mink. Our findings provide crucial information for veterinarians and competent authorities involved in surveillance and outbreak investigation in wild and farmed minks. Findings are published in Transboundary and Emerging Diseases (Article ID 1318901).

Development and Optimization of indirect ELISAs for the Detection of anti-Capripoxvirus Antibodies in Cattle, Sheep and Goat Sera

Sheeppox (SPP), goatpox (GTP) and lumpy skin disease (LSD) are three economically significant pox diseases of ruminants caused by the sheeppoxvirus (SPPV), goatpoxvirus (GTPV), and lumpy skin disease virus (LSDV), respectively. SPPV and GTPV can infect both sheep and goats, while LSDV affects mainly cattle. The recent emergence of LSD in Asia and Europe and the repeated incursions of SPP in Greece, Bulgaria, and Russia highlight the potential of these diseases to spread outside their endemic geographical confinement and stresses the urgent need to develop high throughput serological tools for the surveillance of capripox. We expressed and tested two recombinant truncated proteins, the capripoxvirus homologs of the variola virus C-type lectin-like protein A34 and the EEV glycoprotein A36, as antigens for an indirect ELISA (iELISA) to detect anti-capripoxvirus antibodies. In preliminary specificity tests, A34 outperformed A36 by showing no cross-reactivity to anti-parapoxvirus antibodies. Subsequently, the optimization of the A34 iELISA led to two different working ELISA conditions, one for LSD in cattle, and one for SPP/GTP in sheep and goats. Both displayed sound sensitivities and specificities: 98.81% and 98.72% for the LSD iELISA, and 97.68% and 95.35% for SPP/GTP iELISA, respectively. These ELISAs did not cross-react with anti-parapoxvirus antibodies of cattle, sheep, and goats and could become valuable tools for sero-surveillance and screening of animals for trade; thus, facilitating the implementation of capripox control programs. These finding were disseminated through a peer review publication in the journal Microorganisms (10, 1956. https://doi.org/10.3390/microorganisms10101956).

Capacity Building

The Animal Production and Health Laboratory's new facility for training on frozen semen production

During 2022, a training facility was set up at the Animal Production and Health Laboratory (APHL) to cater to the needs of member states on industrial frozen semen production. The facility will provide training on: (i) collection of semen for artificial breeding of livestock; (ii) extension, processing and packaging of semen; (iii) manual and high throughput freezing and (iv) quality control (post-thaw recovery, computer aided sperm motility analysis, evaluation of frozen semen for morphology, membrane integrity, acrosome integrity, etc.). The facility will train animal breeders and technical personnel working at national artificial insemination centres to set up/scale up indigenous frozen semen production and provide affordable animal breeding services to small holder farmers in member states.

Fellows, Interns and Consultants

Ms Jing Wang joined the Joint FAO/IAEA Centre, Animal Production & Health Laboratory (APHL) as a consultant for AMR in livestock on 1 July 2022. Her main responsibilities include implementing the APHL AMR workplan, providing technical support to member states, contributing to AMR-related capacity-building activities, and conducting relevant studies and research in the laboratory. Ms Wang worked as a regional veterinary officer at WOAH regional representation for Asia and the Pacific for five years.

Ms Chaoying Sun joined the Joint FAO/IAEA Centre, Animal Production & Health Laboratory (APHL) as an intern on 1 September 2022. Ms Sun is now working at APHL to characterize the immune cells' response to irradiated vaccine by immunofluorescence and conduct cytokine expression assays as part of the development of adjuvants.

Mr Kun Cai joined the Joint FAO/IAEA Centre, Animal Production & Health Laboratory (APHL) as an intern on 15 October 2022 and will be working on irradiated micro-organisms as vaccines and immunostimulants. Mr Cai is a Researcher at Pôle de Recherches Sino-Français en Science du Vivant et Génomique, State Key Laboratory of Medical Genomics, Shanghai, China, mainly focusing on hematological viral tumorigenesis with a Ph.D. in Biomedical Science at Shanghai Jiao Tong University.

Coordinated Research Projects (CRPs)

Project Number	Title	Project Officers
D31030	Improving Efficiency of Animal Breeding Programs Using Nuclear Related Genomic Information – Practical Applications in Developing Countries	V. Tsuma G. Viljoen
D31031	Nuclear and Related Techniques to Measure the Impact of Type of Feeding and Production System on Greenhouse Gas (GHG) Emissions and Livestock Productivity	V. Tsuma G. Viljoen
D32034	Use of Stable Isotopes to Trace Bird Migrations and Molecular Nuclear Techniques to Investigate the Epidemiology and Ecology of the Highly Pathogenic Avian Influenza - Phase II	I. Naletoski G. Viljoen
D32035	Improvement of Diagnostic and Vaccine Tools for Emerging and Re-emerging Animal Health Threats	C. Bravo de Rueda V. Wijewardana
D32036	Application of Advanced Molecular Characterization Technologies Through the Veterinary Diagnostic Laboratory Network (VETLAB Network)	I. Naletoski G. Viljoen
D32037	Novel Test Approaches to Determine Efficacy and Potency of Irradiated and Other Vaccines	V. Wijewardana C. Bravo de Rueda
D32038	Enhancing laboratory preparedness for the detection and control of emerging and re-emerging zoonotic diseases – ZODIAC in the Americas and the Caribbean	C. Lamien G. Cattoli
D32039	Enhancing laboratory preparedness for the detection and control of emerging and re-emerging zoonotic diseases – ZODIAC in Asia and the Pacific	C. Lamien G. Cattoli
D32040	Enhancing laboratory preparedness for the detection and control of emerging and re-emerging zoonotic diseases – ZODIAC in Europe and Central Asia	C. Lamien G. Cattoli
D32041	Enhancing laboratory preparedness for the detection and control of emerging and re-emerging zoonotic diseases – ZODIAC in Africa	C. Lamien G. Cattoli

Submission of Proposals

Research contract proposal forms can be obtained from IAEA, the National Atomic Energy Commissions, UNDP offices or by contacting a Project Officer. The form can also be downloaded from http://cra.iaea.org/cra/index.html

Improving Efficiency of Animal Breeding Programs Using Nuclear Related Genomic Information – Practical Applications in Developing Countries (D31030)

Victor Tsuma and Mario Garcia Podesta

Eleven research contracts have been awarded to institutes from various developing countries to commence project activities of this new Coordinated Research Project (CRP) in 2022. The CRP aims to enable use of nuclear and related genomic technologies in Member States to enhance the efficiency of national breeding programs for increased milk productivity and dairy animal adaptability to the production environment. Specifically, the CRP aims to a) develop nuclear and related genomic tools/resources such as radiation hybrid maps and DNA microarrays for tropical dairy species, and b) identify genomic regions of importance for milk and adaptability traits in local dairy animal populations, c) establish strategies to incorporate genomic information for selection and breeding of dairy animals, and d) develop and validate radiolabelled biomarker assays for early pregnancy diagnosis in cattle. Three major dairy animal species viz. cattle, buffalo and camel have been targeted.

Nuclear and Related Techniques to Measure the Impact of Type of Feeding and Production System on Greenhouse Emissions and Livestock Productivity (D31031)

Victor Tsuma and Mario Garcia Podesta

Ten research contracts have been awarded to institutes from various developing countries for this CRP, whose aim is to enable the Member States of the IAEA, particularly among the developing countries, to use nuclear and related technologies and resources to optimize livestock feeding practices that reduce greenhouse gas (GHG) emissions and help mitigate climate change. Specifically, the CRP aims to evaluate nitrogen and energy supplementation strategies in cattle feeding to mitigate enteric and manure GHG emission, and to develop and/or validate nuclear and related tools/resources for nutrition related GHG mitigation in cattle production, and c) to provide MS with tools and mechanisms to monitor livestock GHG emissions. Targeted are dairy cattle production systems.

The research contract will last for five years. Two research agreements were awarded to institutes with expertise in specific areas of importance to the CRP.

Use of Stable Isotopes to Trace Bird Migrations and Molecular Nuclear Techniques to Investigate the Epidemiology and Ecology of the Highly Pathogenic Avian Influenza Phase II (D32034)

Ivancho Naletoski and Gerrit Viljoen

The aim of this Coordinated Research Project (CRP) is to evaluate the origin of wild birds that carry avian influenza (AI) and other potentially dangerous pathogens at their stopover places and match the obtained results with the knowledge obtained through conventional migration monitoring approaches.

Stable isotopes (SI) are promising huge potential when the origin (migration) of individual wild birds is required, because the probability of capturing a labelled bird with specific characteristics (disease carrier) using conventional methods is negligible.

Knowledge and experience obtained through the previous project (D32030 - Use of Stable Isotopes to Trace Bird Migrations and Molecular Nuclear Techniques to Investigate the Epidemiology and Ecology of the Highly Pathogenic Avian Influenza) will be of great value for the success of this project.

The use of SI in migration studies of wild animals, including wild birds, primarily in environmental protection studies and conservation activities, has attracted the attention of the scientific community; however, this technique can also be used in epidemiological studies that target long-range transmission of animal pathogens.

The development and maintenance of the IAEA Global Network of Isotopes in Precipitation (GNIP) became a significant facilitator of these studies, as it offered geo-spatial reference values for correlation of the SI ratios in the animal tissues (especially metabolically inert tissues like beaks, claws and feathers) and the SI ratios in the environment (especially open waters).

During the first phase of this CRP, several important steps in the linking of SI ratios of feather samples (bird migrations) with the epidemiology of AI were established. Achievements of project D32030 have shown not only that the isotope assignment works, but also have delivered a full package of techniques that will strengthen and supplement (SI component) the official wild bird monitoring programmes of Member States.

In the current project, the partners will focus on two critical issues:

a) detecting birds that carry avian influenza viruses and eventually other dangerous pathogens, and

b) evaluating stable isotope ratios in feathers of these birds (only the pathogen carriers) to understand their origins and migration pathways.

The third Research Coordination Meeting is foreseen for November 2023.

Improvement of Diagnostic and Vaccine Tools for Emerging and Re-emerging Animal Health Threats (D32035)

Carla Bravo de Rueda and Viskam Wijewardana

Vaccination has proven to be the best preventive measure against infectious diseases. Despite significant successes, there are several limitations to the currently practiced approaches. In veterinary medicine, the application of vaccines by injection frequently limits their use for small ruminants and poultry. This practice requires well-trained staff taking care to practice the utmost hygiene and maintain vaccine cold chain. Further, also in poultry rearing it is not easy to inject individual birds. In addition to that, injected vaccines rarely induce production of specific mucosal antibodies (IgA) covering the mucosal tissues in the nose, mouth and lungs, which are the primary site of multiplication for bacteria or viruses before they provoke a systemic infection. Such IgA antibodies can efficiently be induced by ‘mucosal’ vaccines, i.e. formulations that are

applied to the nose, mouth or eyes. These mucosal vaccines, especially eye drop vaccines, have the big advantage in requiring small volumes as the vaccine dose. Therefore, the application can be done by village vaccinators and the cold chain will be relatively easy to maintain.

Recent experiments on formulating such mucosal vaccines have presented a number of challenges: a) low viscosity leading to spills; b) unsuitable components for freeze drying; and c) the process of formulating the components appropriately. Among the latest development of this Coordinated Research Project is the research on Fowl cholera (FC) caused by Pasteurella multocida conducted in Ethiopia. When the irradiated FC vaccine was administered to chickens through intranasal and intraocular routes, a 100% protection was observed, as compared to a much lower rate with intramuscular injection. This work is now published in the major research journal "Frontiers in Immunology". Pakistan has improved their viral vaccine production titres significantly using a Celcradle system and have also shown efficacy of their ocular vaccines by improving its immune response. This work has been published in international conferences and symposiums and has been submitted as manuscript. Indonesia has shown progress on the irradiation of the bacteria with maintenance of metabolic activity. Kenya has shown progress on pathogens detection by PCR and has initiated students' programmes. The next research coordination meeting will be in October 2023.

Application of Advanced Molecular Characterization Technologies Through the Veterinary Diagnostic Laboratory Network (VETLAB Network) (D32036)

Ivancho Naletoski and Charles Lamien

The Animal Production and Health Section (APH) of the Joint FAO/IAEA Centre has established a free-of-charge Sanger sequencing service for all counterparts of the subprogramme. So far, over 4000 samples have been submitted for Sanger sequencing by 30 counterpart laboratories (mainly partners in the VETLAB Network) and the results were published in 27 articles in peer reviewed journals.

The APH intends to upgrade this service with additional workflows which should enable counterparts' access to service-based Whole Genome Sequencing (WGS) including the possibility for metagenomic analysis.

Such workflows need to be validated, primarily for biological inactivation of the field samples prior to submission, as well as regarding the quality of the DNA / RNA extracted from the field samples. Additionally, standardized bio-informatic package for processing of the raw data and further phylogenetic analysis needs to be validated and verified for use by the counterpart community. In order to perform these activities, a new Coordinated Research Project (CRP) was developed and approved by the management of IAEA. Priority targets for this CRP will be the established users of the Sanger sequencing service of APH. However, the final objective of the CRP is to further disseminate the validated workflows to the wider counterparts' community.

Novel Test Approaches to Determine Efficacy and Potency of Irradiated and Other Vaccines (D32037)

Viskam Wijewardana and Carla Bravo de Rueda

The aim of this new Coordinated Research Project (CRP) is to complement the evaluation efforts of irradiated and other novel vaccines, as well as application of innovative tools, to determine the immune response and design immunological tools for quality control and efficacy. The overall expected outcomes are a) new in vitro procedures for vaccine efficacy testing replacing or reducing animal challenge trials based on in vitro assays ideally employing irradiated antigens, b) evaluation of immune marker mRNA qPCR and gene expression assays, c) cytokine protein assays like ELISPOTS or ELISA, and d) cell-based quantification assays that employ flow cytometry etc.

This CRP will not support the development of technical capacities, instead it requires the inputs from the side of each participant for us to be able to understand the immune response delivered by the specific vaccine and the basic methods of their evaluation. It is expected that these new procedures will in the future help vaccine producing labs to perform better quality control of their products. They will allow a higher confidence in the results due to a more technical approach. Six research contracts (Cameroon, Ethiopia, Indonesia, Iran, Sri Lanka, Tunisia), 2 agreements (Ethiopia, United Kingdom) and 1 technical contract (Italy) has been awarded under this CRP. The first research coordination meeting (RCM) was held as a hybrid (virtual and on-site) meeting, from 18 to 22 July 2022, in Vienna, Austria.

Enhancing laboratory preparedness for the detection and control of emerging and re-emerging zoonotic diseases – ZODIAC in the Americas and the Caribbean (D32038)

Charles Lamien and Giovanni Cattoli

Multiple zoonotic diseases have impacted public health, peoples' livelihoods, and the global economy in the last few decades. The COVID-19 pandemic is the most recent severe threat, which will have a long-term and far-reaching influence on the population and economy worldwide.

Surveillance and early detection tools and technologies are the critical links in the chain of disease control. They enable the rapid discovery of source and movement of pathogens as well as analysis, planning, and decision-making through the design and implementation of preventive or control measures.

Nuclear, nuclear-derived and -related techniques are reliable tools that can help scientists to investigate, prevent, detect, and contain outbreaks of zoonotic diseases. In addition, the IAEA has considerable experience in assisting the Member States in building their capacity to detect and characterize pathogens early and diagnose diseases rapidly and accurately. Moreover, the IAEA has developed or contributed to developing early detection and characterization tools, nowadays recognized as international testing standards.

Over the last few decades, technological development has enabled miniaturization and multiplexing of diagnostic assays, thus opening new windows in understanding the ecology and evolution of zoonotic pathogens. Next-generation sequencing, nanopore sequencing, and metagenomics-based approaches will enable novel pathogen characterization and discovery and will help to find potential reservoirs, vectors and additional susceptible hosts for known zoonotic pathogens.

The ZODIAC CRP for the Americas and the Caribbean aims to develop and validate immunological and molecular tools under Pillar 2 of the ZODIAC project. On this way empowering national and regional disease surveillance programs in the Americas and the Caribbean to identify potential sources of pathogen spill over to humans and identify emerging- and/or re-emerging pathogens with zoonotic risk.

Priority diseases	Examples	Research areas
Respiratory viruses	*Influenza A, Zoonotic Coronoviruses*	Increased (-targeted) surveillance at the A-H interface; sampling procedures
Arboviruses	Zika, Dengue	Early detection, monitoring and surveillance in the animal reservoirs and vectors, point-of-care testing
Emerging zoonoses	*Hantaviruses, Arenaviruses*	Increased surveillance at the A-H interface; sampling procedures, point-of-care testing
Endemic zoonoses	*Rabies, Brucellosis*	Increased surveillance at the A-H interface; point-of-care testing

TARGETED DISEASES/PATHOGENS

Enhancing laboratory preparedness for the detection and control of emerging and re-emerging zoonotic diseases – ZODIAC in Asia and the Pacific (D32039)

Charles Lamien and Giovanni Cattoli

Multiple zoonotic diseases have impacted public health, peoples' livelihoods, and the global economy in the last few decades. The COVID-19 pandemic is the most recent severe threat, which will have a long-term and far-reaching influence on the population and economy worldwide.

Surveillance and early detection tools and technologies are the critical links in the chain of disease control. They enable the rapid discovery of source and movement of pathogens as well as analysis, planning, and decision-making through the design and implementation of preventive or control measures.

Nuclear, nuclear-derived and -related techniques are reliable tools that can help scientists to investigate, prevent, detect, and contain outbreaks of zoonotic diseases. In addition, the IAEA has considerable experience in assisting the Member States in building their capacity to detect and characterize pathogens early and diagnose diseases rapidly and accurately. Moreover, the IAEA has developed or contributed to developing early detection and characterization tools, nowadays recognized as international testing standards.

Over the last few decades, technological development has enabled miniaturization and multiplexing of diagnostic assays, thus opening new windows in understanding the ecology and evolution of zoonotic pathogens. Next-generation sequencing, nanopore sequencing, and metagenomics-based approaches will enable novel pathogen characterization and discovery and will help to find potential reservoirs, vectors and additional susceptible hosts for known zoonotic pathogens.

The ZODIAC CRP for Asia and the Pacific aims to develop and validate immunological and molecular tools under Pillar 2 of the ZODIAC project. On this way empowering national and regional disease surveillance programs in Asia and the Pacific to identify potential sources of pathogen spill over to humans and identify emerging- and/or re-emerging pathogens with zoonotic risk.

Priority diseases	Examples	Research areas
Respiratory diseases	*Influenza A viruses, Coronaviruses, Henipaviruses*	Increased (-targeted) surveillance at the A-H interface; sampling procedures
Arboviral diseases	*Tick-borne, mosquito-borne, and those transmitted by Culicoides and sand flies*	Early detection, monitoring and surveillance in the animal reservoirs and vectors, point-of-care testing
Haemorrhagic fevers	*caused by Filoviruses*	Increased surveillance at the A-H interface; sampling procedures, point-of-care testing
Waterborne diseases	*caused by Hepevirus, Leptospira, and others*	
Endemic zoonoses	*Rabies, Brucellosis*	Increased surveillance at the A-H interface; point-of-care testing.

TARGETED DISEASES/PATHOGENS

Enhancing laboratory preparedness for the detection and control of emerging and re-emerging zoonotic diseases – ZODIAC in Europe and Central Asia (D32040)

Charles Lamien and Giovanni Cattoli

Multiple zoonotic diseases have impacted public health, peoples' livelihoods, and the global economy in the last few decades. The COVID-19 pandemic is the most recent severe threat, which will have a long-term and far-reaching influence on the population and the economy worldwide.

Surveillance and early detection tools and technologies are the critical links in the chain of disease control. They enable the rapid discovery of source and movement of pathogens as well as analysis, planning, and decision-making through the design and implementation of preventive or control measures.

Nuclear, nuclear-derived and -related techniques are reliable tools that can help scientists to investigate, prevent, detect, and contain outbreaks of zoonotic diseases. In addition, the IAEA has considerable experience in assisting the Member States in building their capacity to detect and characterize pathogens early and diagnose diseases rapidly and accurately. Moreover, the IAEA has developed or contributed to developing early detection and characterization tools, nowadays recognized as international testing standards.

Over the last few decades, technological development has enabled miniaturization and multiplexing of diagnostic assays, thus opening new windows in understanding the ecology and evolution of zoonotic pathogens. Next-generation sequencing, nanopore sequencing, and metagenomics-based approaches will enable novel pathogen characterization and discovery and will help to find potential reservoirs, vectors and additional susceptible hosts for known zoonotic pathogens.

The ZODIAC CRP for Europe and Central Asia aims to develop and validate immunological and molecular tools under Pillar 2 of the ZODIAC project. On this way empowering national and regional disease surveillance programs in Europe and Central Asia to identify potential sources of pathogen spill over to humans and identify emerging

Priority diseases	Examples	Research areas
Vector-borne diseases	*Tick-borne, mosquito-borne, and those transmitted by Culicoides and sand flies, e.g., Flaviviruses (WNV, TBEV) and Bunyaviruses (Hantaviruses, CCHFV, RVFV)*	Early detection, monitoring and surveillance in animal reservoirs and vectors, point-of-care testing
Respiratory diseases	*Influenza A viruses, zoonotic coronaviruses*	Increased (targeted) surveillance at the vector, animal and human levels, sampling procedures
Foodborne diseases		Increased surveillance at the animal-human interface
Endemic zoonoses	*Rabies, anthrax, Lyme borreliosis, leishmaniosis*	Increased surveillance at the animal-human interface; point-of-care testing.
Endemic zoonoses	*Rabies, Brucellosis*	Increased surveillance at the A-H interface; point-of-care testing.

TARGETED DISEASES/PATHOGENS

Enhancing laboratory preparedness for the detection and control of emerging and re-emerging zoonotic diseases – ZODIAC in Africa (D32041)

Charles Lamien and Giovanni Cattoli

Multiple zoonotic diseases have impacted public health, peoples' livelihoods, and the global economy in the last few decades. The COVID-19 pandemic is the most recent severe threat, which will have a long-term and far-reaching influence on the population and economy worldwide.

Surveillance and early detection tools and technologies are the critical links in the chain of disease control. They enable the rapid discovery of source and movement of pathogens as well as analysis, planning, and decision-making through the design and implementation of preventive or control measures.

Nuclear, nuclear-derived and related techniques are reliable tools that can help scientists to investigate, prevent, detect, and contain outbreaks of zoonotic diseases. In addition, the IAEA has considerable experience in assisting the Member States in building their capacity to detect and characterize pathogens early and diagnose diseases rapidly and accurately. Moreover, the IAEA has developed or contributed to developing early detection and characterization tools, nowadays recognized as international testing standards.

Over the last few decades, technological development has enabled miniaturization and multiplexing of diagnostic assays, thus opening new windows in understanding the ecology and evolution of zoonotic pathogens. Next-generation sequencing, nanopore sequencing, and metagenomics-based approaches will enable novel pathogen characterization and discovery and will help to find potential reservoirs, vectors and additional susceptible hosts for known zoonotic pathogens.

The ZODIAC CRP for Africa aims to develop and validate immunological and molecular tools under Pillar 2 of the ZODIAC project. On this way empowering national and regional disease surveillance programs in Africa to identify potential sources of pathogen spill over to humans and identify emerging- and/or re-emerging pathogens with zoonotic risk.

Priority diseases	Examples	Research areas
Haemorrhagic diseases	Lassa fever, Marburg disease, Ebola, Crimean-Congo haemorrhagic fever, Rift valley fever	Early detection, monitoring and surveillance in animal reservoirs and vectors
(Re-) Emerging zoonoses	Zoonotic Coronaviruses, avian influenza, monkeypox	Surveillance and monitoring in animal reservoirs; NGS
Other mosquito-borne diseases	Chikungunya, West Nile, Zika, Dengue, Yellow fever	Differential diagnosis and syndromic surveillance
Rabies		Increased animal surveillance, differential diagnosis, vaccination programmes
Endemic zoonoses	Anthrax, Bovine TB, Brucellosis and zoonotic parasites	Differential diagnosis and syndromic surveillance

TARGETED DISEASES/PATHOGENS

Technical Cooperation Projects

Country TC Number	Description	Technical Officer(s)
Albania ALB5008	Improving and Enhancing National Capabilities for Early Detection of Vector Borne Diseases through the Application of Conventional and Molecular Methods	I. Naletoski
Algeria ALG5032	Strengthening the Capacity of the Central Veterinary Laboratory, Regional Laboratories and the Early Warning Laboratories in the Detection, Confirmation of Diagnosis and Surveillance of Animal and Zoonotic Diseases	I. Naletoski
Angola ANG5016	Recovering the Vaccine Production Unit and Monitoring Active Animal Immunity	V. Wijewardana C. Bravo de Rueda
Angola ANG5017	Optimizing Pasture Utilization for Improved Livestock Productivity	V. Tsuma
Burundi BDI5002	Improving Animal Production Through Enhanced Application of Nuclear and Related Techniques	C. Bravo de Rueda I. Naletoski V. Tsuma
Benin BEN5014	Improving Sheep and Pig Productivity and Livestock Traceability	V. Tsuma
Burkina Faso BKF5021	Improving Local Poultry Production Through Incorporation of Nutraceuticals in Feeds and Genetic Characterization	V. Tsuma
Burkina Faso BKF5022	Improving Local Poultry and Local Goat Productivity through Health, Diet, Reproduction, Genetic Markers for Selection and Breeding Management	V. Tsuma
Bosnia and Herzegovina BOH5002	Strengthening State Infrastructure for Food and Animal Food Control and Protecting Animal Health	I. Naletoski
Botswana BOT5018	Reducing the Incidence and Impact of Transboundary Animal and Zoonotic Diseases	C. Lamien
Botswana BOT5021	Improving Reproductive and Productive Performance of Crossbred Dairy Cattle	G. Viljoen
Botswana BOT5022	Strengthening Animal Health and Production	G. Viljoen C. Lamien
Bulgaria BUL5017	Enhancing the National Diagnostic Capabilities for Detection of Hepatitis E Virus in Pigs and Pig Products	I. Naletoski
Belize BZE5010	Strengthening National Capacities to Control Animal Diseases	G. Viljoen
Central African Republic CAF5010	Building National Capacities for the Diagnosis and Control of Animal Diseases and for Increasing Animal Production	C. Bravo de Rueda G. Viljoen
Chad CHD5008	Improving Bovine Productivity Using Artificial Insemination	V. Tsuma
Chad CHD5010	Eradicating Pests in Small Ruminants Using Nuclear Technology	M. Garcia C. Bravo de Rueda
Chile CHI0022	Building Capacity for Nuclear Science and Technology Applications	C. Bravo de Rueda

Country TC Number	Description	Technical Officer(s)
Cameroon CMR5022	Controlling Transboundary Animal diseases with Special Emphasis on Peste des Petits Ruminants	V. Tsuma
Cameroon CMR5024	Improving Goat and Sheep Productivity in Rural Areas Using Nuclear-Derived Techniques for Genetic Marker Identification, Reproduction Harnessing and Feed Analysis	V. Tsuma
Colombia COL6017	Establishing a New Oncology Unit at the Carlos Ardila Lülle Hospital for the Improvement of Quality of Life in Children and Adult Patients with Cancer	I. Naletoski
People's Republic of China CPR5025	Developing Integrated Strategies to Improve Nitrogen Utilization and Production Efficiency in Dairy Cows	G. Viljoen
Dominican Republic DOM0006	Building and Strengthening the National Capacities and Providing General Support in Nuclear Science and Technology	C. Bravo de Rueda
El Salvador ELS5014	Strengthening National Capacities for the Control of Brucellosis	I. Naletoski
Eritrea ERI5010	Increasing Small Scale Dairy Production Through Improved Feeding, Cattle Management and Higher Conception Rates, Thereby Improving Rural Livelihood and Contributing to Food Security	V. Tsuma
Ethiopia ETH5020	Enhancing the Livelihood of Rural Communities through Addressing Major Zoonotic and Economically Important Small Ruminant Diseases	C. Lamien
Grenada GRN0001	Building National Capacity through the Applications of Nuclear Technology	V. Tsuma
Indonesia INS5042	Improving Cattle Productivity Through Improved Feeding and Enhanced Reproduction	V. Tsuma
INT5155	Sharing Knowledge on the Sterile Insect and Related Techniques for the Integrated Area-Wide Management of Insect Pests and Human Disease Vectors	I. Naletoski
INT5157	Supporting National and Regional Capacity in Integrated Action for Control of Zoonotic Diseases	I. Naletoski
Côte d'Ivoire IVC5038	Studying Small Ruminant Respiratory Diseases	C. Lamien
Côte d'Ivoire IVC5043	Applying Nuclear and DNA-Based Techniques to Improve Productivity of Local Livestock	V. Tsuma
Cambodia KAM5003	Supporting Sustainable Livestock Production	M. Garcia
Cambodia KAM5009	Improving Livestock Productivity and Control of Transboundary Animal Diseases	G. Viljoen
Kenya KEN5038	Using Nuclear Techniques to Evaluate and Improve the Impact of Mutated Forages on the Performance of Smallholder Dairy Cows	M. Garcia
Kenya KEN5039	Using Nuclear and Nuclear Related Technologies for Sustainable Livestock Productivity	V. Tsuma
Kyrgyzstan KIG5001	Establishing Effective Testing and Systematic Monitoring of Residues and Food Contaminants and of Transboundary Animal Diseases	I. Naletoski
Lao P.D.R. LAO5003	Using Nuclear and Molecular Techniques for Early and Rapid Diagnosis and Control of Transboundary Animal Diseases in Livestock	G. Viljoen

Country TC Number	Description	Technical Officer(s)
Lao P.D.R. LAO5004	Enhancing National Capability for Crop Production and Controlling Trans-Boundary Animal Diseases	G. Viljoen
Lao P.D.R. LAO5005	Reducing the Incidence and Impact of Transboundary Animal and Zoonotic Diseases	G. Viljoen
Lao P.D.R. LAO5007	Strengthening National Animal Health Laboratory Network	G. Viljoen
Lesotho LES5006	Enhancing Animal Production and the Health of Sheep and Goats in Lesotho	G. Viljoen
Lesotho LES5007	Enhancing Livestock Production and Health	G. Viljoen
Lesotho LES5010	Using Nuclear and Molecular Technology to Improve Livestock Production and Health	G. Viljoen
Madagascar MAG5020	Improving Stockbreeding Productivity Through the Application of Nuclear and Related Techniques for Reducing Rural Poverty	I. Naletoski
Madagascar MAG5024	Applying Nuclear and DNA-Based Techniques to Improve Productivity of Local Livestock	V. Tsuma
Madagascar MAG5027	Improving Livestock Production through Artificial Insemination and Disease Control	V. Tsuma
North Macedonia MAK5011	Improving National Capacities for Early Detection and Characterization of Emerging and Re-emerging Animal Diseases with Strong Economic Consequences and Upgrade of the Bio Risk Management at the National Laboratory	I. Naletoski
Malaysia MAL5034	Strengthening National Capacity and Capability in Nuclear and Molecular Techniques in Supporting Transboundary Animal and Zoonotic Diseases of Veterinary Public Health Significance	C. Bravo de Rueda
Mauritania MAU5007	Supporting Genetic Improvement of Local Cattle Breeds and Strengthening the Control of Cross-Border Diseases - Phase II	M. Garcia
Mexico MEX5033	Sustainable Production of Sheep and Goats in Mexico using Nuclear and Nuclear Related Techniques	V. Tsuma
Mali MLI5027	Using Nuclear and Molecular Techniques for Early and Rapid Diagnosis, Epidemiological Surveillance and Control of Transboundary Animal Diseases	I. Naletoski
Mali MLI5029	Upgrading Capacities to Differentiate Priority Animal and Zoonotic Diseases Using Nuclear Related Molecular Techniques	I. Naletoski
Malawi MLW5002	Strengthening Capacity for the Diagnosis, Prevention and Control of Animal Diseases of Public Health Importance	C. Bravo de Rueda
Malawi MLW5004	Strengthening Capacity for the Diagnosis and Control of Mastitis in Dairy Cattle	C. Bravo de Rueda
Montenegro MNE5005	Enhancing Capacity of the National Veterinary Laboratory for Detection of Highly Contagious Animal Diseases	I. Naletoski
Mongolia MON5023	Enhancing Livestock Production Through the Improved Diagnosis and Prevention of Transboundary Animal Diseases	C. Bravo de Rueda G. Viljoen
Mongolia MON5025	Improving Breed Characterization of Cashmere Goats to Facilitate the Establishment of Strategic Breeding Programmes	G. Viljoen
Mongolia MON5026	Improving the Diagnosis and Treatment of Transboundary Animal Diseases with Potential Pandemic Patterns	G. Viljoen

Country TC Number	Description	Technical Officer(s)
Morocco MOR5039	Strengthening National Capacities for the Control and Prevention of Viral Pandemics and Drug Resistant Pathogens	I. Naletoski
Mozambique MOZ5008	Strengthening National Capacity for the Application of Nuclear and Related Techniques to Improve Animal Health and Production	G. Viljoen
Mozambique MOZ5009	Strengthening National Capacity to Control the Incidence and Impact of Transboundary Animal and Zoonotic Diseases	G. Viljoen
Mozambique MOZ5011	Using Nuclear and Nuclear Related Techniques to Improve Animal Health and Breeding	G. Viljoen
Myanmar MYA5026	Improving the Livelihoods of Smallholder Livestock Farmers by Developing Animal Feeding Strategies for Enhanced Food Security	G. Viljoen
Myanmar MYA5028	Reducing the Incidence and Impact of Transboundary Animal and Zoonotic Diseases	G. Viljoen
Myanmar MYA5030	Advancing National Capacities to Detect and Respond to Transboundary Animal Diseases	G. Viljoen T.B. Settypalli
Namibia NAM5018	Strengthening Animal Health and Food Safety Control Systems	G. Viljoen
Nepal NEP5005	Strengthening Capacity in Veterinary Diagnosis	I. Naletoski
Nepal NEP5008	Reducing the Incidence of Brucellosis in Animals and Humans through Surveillance and Control	I. Naletoski
Vanuatu NHE5003	Enhancing Livestock Production and Health	V. Tsuma C. Bravo de Rueda
Nigeria NIR5040	Controlling Parasitic and Transboundary Animal Diseases to Improve Animal Productivity in Smallholder Farms Using Nuclear and Molecular Techniques	I. Naletoski
Nigeria NIR5041	Improving Livestock Productivity through Enhanced Nutrition and Reproduction Using Nuclear and Molecular Techniques	V. Tsuma
Pakistan PAK5052	Improving Livestock Productivity Using Nuclear and Related Techniques by Exploiting Indigenous Feed Resources while Reducing Enteric Greenhouse Gas Emissions	M. Garcia C. Bravo de Rueda
Palestine PAL5007	Upgrading Animal Feeding Laboratory in Terms of Human Capacity Building and Infrastructure	I. Naletoski
Papua New Guinea PAP5004	Improving Reporting of the Incidence and Prevalence of Animal Health and Diseases Using Nuclear Derived Techniques	I. Naletoski
Paraguay PAR5011	Improving the Conservation of Germplasm of High-Performance Livestock and Native Cattle	M. Garcia
Peru PER5035	Improving Pasture Production Through Best Soil Nutrient Management To Promote Sustainable Livestock Production in the Highland Region	V. Tsuma
Palau PLW5004	Establishing Technical Capability in Animal Production and Disease Control	C. Bravo de Rueda
Congo PRC5001	Monitoring Livestock Diseases and Certifying Animal Health	C. Bravo de Rueda
Congo PRC6002	Contributing to the Epidemiological Surveillance of Neglected Tropical Diseases	C. Bravo de Rueda

Country TC Number	Description	Technical Officer(s)
RAF0042	Promoting the Sustainability and Networking of National Nuclear Institutions for Development	I. Naletoski
RAF0051	Supporting Specific Needs in the African Region Due to Emergencies	I. Naletoski G. Viljoen
RAF5068	Improving Livestock Productivity through Strengthened Transboundary Animal Disease Control using Nuclear Technologies to Promote Food Security (AFRA)	C. Lamien
RAF5073	Strengthening Africa's Regional Capacity for Diagnosis of Emerging or Re-emerging Zoonotic Diseases, including Ebola Virus Disease (EVD), and Establishing Early Warning Systems	I. Naletoski
RAF5082	Enhancing Veterinary Diagnostic Laboratory Biosafety and Biosecurity Capacities to Address Threats from Zoonotic and Transboundary Animal Diseases (AFRA)	I. Naletoski
RAF5089	Strengthening the Capacities of National Veterinary Laboratories for the Early Warning, Control and Prevention of Outbreaks of Animal and Zoonotic Diseases (AFRA)	C. Bravo de Rueda G. Cattoli
RAF5090	Supporting Climate Change Adaptation for Communities Through Integrated Soil–Cropping–Livestock Production Systems (AFRA)	V. Tsuma
RAS0081	Supporting Human Resource Development and Nuclear Technology Including Emerging Needs	G. Viljoen
RAS5078	Enhancing Food Safety Laboratory Capabilities and Establishing a Network in Asia to Control Veterinary Drug Residues and Related Chemical Contaminants	G. Viljoen
RAS5085	Using Nuclear Derived Techniques in the Early and Rapid Detection of Priority Animal and Zoonotic Diseases with Focus on Avian Influenza	I. Naletoski
RER5025	Improving Early Detection and Rapid Response to Potential Outbreaks of Priority Animal and Zoonotic Diseases	I. Naletoski
RER5027	Enhancing Preparedness Capacities of the Veterinary Sector to Confront with Emerging and Re-emerging Diseases of Livestock and Wildlife	I. Naletoski
RLA5071	Decreasing the Parasite Infestation Rate of Sheep (ARCAL CXLIV)	M. Garcia
RLA5084	Developing Human Resources and Building Capacity of Member States in the Application of Nuclear Technology to Agriculture	C. Bravo de Rueda
RLA5085	Strengthening the Capacity of Official Laboratories for Monitoring and Response to an Outbreak of Priority Animal and Zoonotic Diseases (ARCAL CLXXIV)	C. Bravo de Rueda I. Naletoski
RLA5086	Decreasing the Mortality Rate of Rainbow Trout Associated with Infectious Pancreatic Necrosis Virus and Emerging Diseases Using Molecular and OMIC Techniques (ARCAL CLXXV)	M. Garcia
Senegal SEN5036	Controlling Mycoplasma Mycoides Infection — Contagious Bovine Pleuropneumonia (CBPP) and Contagious Caprine Pleuropneumonia (CCPP)	C. Bravo de Rueda
Senegal SEN5042	Using Nuclear and Related Techniques in Improving the Productivity of Domestic Ruminants	V. Tsuma
Sierra Leone SIL5019	Strengthening Capacities for the Diagnosis and Control of Zoonoses to Improve Public Health Services and Livestock Production	C. Bravo de Rueda G. Viljoen

Country TC Number	Description	Technical Officer(s)
Sierra Leone SIL5022	Enhancing Livestock Production and Artificial Insemination Programme to Increase Milk and Meat Production in Cattle	V. Tsuma
Serbia SRB5004	Strengthening of National Reference Laboratories Capacities for Early Detection, Epidemiological Surveillance and Control of Transboundary Animal Diseases in Emergency Situations	I. Naletoski
Sri Lanka SRL5046	Improving Livelihoods Through Dairy Cattle Production: Women Farmers' Empowerment	M. Garcia
Sri Lanka SRL5049	Supporting Control of Stomach Worm Infection in Goats	C. Bravo de Rueda V. Wijewardana
Kingdom of Eswatini SWA5001	Reducing the Incidence and Impact of Transboundary Animal and Zoonotic Diseases	G. Viljoen
Syrian Arab Republic SYR5025	Enhancing the Nutritive and Reproductive Characteristics of Small Ruminants by Means of Nuclear and other Related Techniques Using Locally Available Unconventional Feed Resources	M. Garcia
Tajikistan TAD5006	Applying Nuclear and Molecular Techniques for Diagnosis and Control of Transboundary Animal Diseases	I. Naletoski
Togo TOG5001	Improving and Promoting Bovine Milk Production through Artificial Insemination	M. Garcia
Togo TOG5003	Improving Livestock Production and Milk Quality Using Artificial Insemination	V. Tsuma
Togo TOG5005	Enhancing Animal Production Using Artificial Insemination	V. Tsuma
Tunisia TUN5030	Enhancing Feed and Food Safety by Appropriate Management of Livestock Feed Resources for Safer Products	M. Garcia
Tunisia TUN5032	Establishing a National Certified Pipeline to Produce Aquaculture Vaccines by Irradiation	V. Wijewardana R. Kangethe
Ukraine UKR5001	Building Laboratory Capacity for Diagnostics, Surveillance and Prevention of Emerging Animal Diseases	I. Naletoski
U.R. of Tanzania URT5031	Improving Indigenous Cattle Breeds through Enhanced Artificial Insemination Service Delivery in Coastal Areas	V. Tsuma
U.R. of Tanzania URT5036	Enhancing Artificial Insemination Services and Application of Radioimmunoassay Techniques to Improve Dairy Cattle Productivity	V. Tsuma
Viet Nam VIE5023	Reducing the Incidence and Impact of Transboundary Animal and Zoonotic Diseases	G. Viljoen
Viet Nam VIE5024	Strengthening Diagnosis, Surveillance, and Control of Emerging Transboundary Animal and Zoonotic Diseases with Emphasis on African Swine Fever and Severe Acute Respiratory Syndrome Coronavirus 2	G. Viljoen
Viet Nam VIE5025	Applying Nuclear Related Technology for Selecting Climate Adapted Indigenous Swine and Chicken Breeds	G. Viljoen V. Tsuma
DR Congo ZAI5027	Developing Early and Rapid Diagnosis and Control of Transboundary and Zoonotic Diseases	C. Bravo de Rueda

Country TC Number	Description	Technical Officer(s)
Zimbabwe ZIM5024	Establishing an Artificial Insemination Center to Enhance the Rebuilding of the National Herd	V. Tsuma
Zimbabwe ZIM5025	Producing Theileriaparva and Other Tick Borne Disease Vaccines	C. Bravo de Rueda

Publications

Publications in Scientific Journals

Manomohan V, Saravanan R, **Pichler R**, Murali N, Sivakumar K, Sudhakar K, Raja KN, S.O. Peters SO, **Kathiravan Periasamy.** (2022) Assessment of Mutation Drift Equilibrium and the Occurrence of a Recent Genetic Bottleneck in South Indian Zebu Cattle. Animals 12, 1838. https://doi.org/10.3390/ani12141838.

Lv FH, Cao YH, Liu GJ, Luo LY, .., **Kathiravan Periasamy K**, Johansson AM, Hallsson JH, Kantanen J, Coltman DW, Bruford MW, Lenstra JA, Li MH (2022) Whole-Genome Resequencing of Worldwide Wild and Domestic Sheep Elucidates Genetic Diversity, Introgression, and Agronomically Important Loci. Molecular Biology and Evolution 3, 39(2): msab353. doi: 10.1093/molbev/ msab353.

Dubey PK, Dubey S, Aggarwal SJ, **Kathiravan Periasamy**, Mukesh M, Dige MS, Mishra BP, Kataria RS. (2022). Identification of novel polymorphism in mammary-derived growth inhibitor gene of water buffalo and its expression analysis in the mammary gland. Animal Biotechnology, DOI: 10.1080/10495398.2022. 2126980.

Molini U, Franzo G, **Settypalli TBK**, Hemberger MY, Khaiseb S, **Cattoli G**, **Dundon WG**, **Lamien CE**. Viral Co-Infections of Warthogs in Namibia with African Swine Fever Virus and Porcine Parvovirus 1. Animals (Basel). 2022 Jun 30;12(13):1697. doi: 10.3390/ani12131697.

Franzo G, **Dundon WG**, De Villiers M, De Villiers L, Coetzee LM, Khaiseb S, **Cattoli G**, Molini U. Phylodynamic and phylogeographic reconstruction of beak and feather disease virus epidemiology and its implications for the international exotic bird trade. Transbound Emerg Dis. 2022 Jun 13. doi: 10.1111/tbed.14618.

Bortolami A, Mazzetto E, **Kangethe RT**, **Wijewardana V**, Barbato M, **Porfiri L**, Maniero S, Mazzacan E, Budai J, Marciano S, Panzarin V, Terregino C, Bonfante F, **Cattoli G.** Protective Efficacy of H9N2 Avian Influenza Vaccines Inactivated by Ionizing Radiation Methods Administered by the Parenteral or Mucosal Routes. Front Vet Sci. 2022 Jul 11;9:916108. doi: 10.3389/fvets.2022.916108.

Luka PD, Adedeji AJ, Jambol AR, Ifende IV, Luka HG, Choji ND, Weka R, **Settypalli TBK**, Achenbach JE, **Cattoli G**, **Lamien CE**, Molini U, Franzo G, **Dundon WG**. Coinfections of African swine fever virus, porcine circovirus 2 and 3, and porcine parvovirus 1 in swine in Nigeria. Arch Virol. 2022 Sep 22. doi:10.1007/s00705-022-05593-6.

Berguido FJ, Gelaye E, Liu Y, Davaasuren B, Krstevski K, Djadjovski I, Ivanova E, Goujgoulova G, Loitsch A, Tuppurainen E, Chibssa TR, Caufour P, Samojlović M, Lazić S, Petrović T, Vidanović D, Bertagnoli S, Grabherr R, Diallo A, **Cattoli G**, **Lamien CE**. Development and Optimization of Indirect ELISAs for the Detection of Anti-Capripoxvirus Antibodies in Cattle, Sheep, and Goat Sera. Microorganisms. 2022 Sep 30;10(10):1956. doi: 10.3390/microorganisms10101956.

Molini U, De Villiers M, De Villiers L, Coetzee LM, Hoebes E, Khaiseb S, **Cattoli G**, **Dundon WG**, Franzo G. Investigation and sequence analysis of psittacine beak and feather disease virus and avian polyomavirus from companion birds in Windhoek, Namibia. Acta Trop. 2022 Nov 11:106739. doi:10.1016/j.actatropica.2022.106739.

VETLAB Network

The Veterinary Diagnostic Laboratory (VETLAB) Network is a global network of national veterinary laboratories coordinated by the Animal Production and Health Section (APH) and supported through IAEA and FAO programmatic activities as well as by South Africa through the African Renaissance Fund (ARF) and by the USA and Japan Peaceful Uses Initiative (PUI). To date, the network comprises 72 laboratories in 46 African and 19 Asian countries and is now working to expand to Central and Eastern Europe, the Caribbean and Latin America. The laboratories work with each other and experts from the Joint FAO/IAEA Centre to use nuclear, nuclear-derived and other methods for monitoring, early detection, diagnosis and control of diseases.

Every year the VETLAB Network organizes ring trials, training courses and one meeting of the Directors of African and Asian laboratories.

In 2022, the meeting of the Directors of the partner laboratories was organized at the IAEA Headquarters in Vienna, Austria, from 22 to 26 August. Twenty-nine directors of VETLAB partner laboratories attended the event. In addition, representatives of the FAO Animal Health Services, FAO Regional Office for Asia and the Pacific, the Pasteur Institute of Cambodia, and the Enhancing Research for Africa Network (ERFAN) were also present.

The VETLAB Network also organized two training courses for the partners, both held at the IAEA training facilities in Seibersdorf, Austria. On 19 to 30 September 2022, the Training Course on Transboundary Animal Diseases: Early Diagnosis and Pathogen Characterization was conducted with the participation of 30 scientists. The second training was conducted from 17 to 28 October 2022 and focused on the Detection and Differential Diagnosis of Peste des Petits Ruminants in Small Ruminants and other Non-Conventional Hosts. Twenty-nine scientists from VETLAB partner laboratories in Asia and Africa participated in this course.

In the second half of 2022, network partner laboratories in Africa and Asia have been supported for the detection, confirmation, and control of transboundary animal diseases such as avian influenza H5N1, foot-and-mouth disease, African swine fever (ASF) and lumpy skin disease (LSD).

More information can be found in other sections of this newsletter. APH is issuing the VETLAB on a regular basis 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 highlights of the VETLAB Network Bulletin can be found on pages 6 and 7 of this issue.

Impressum

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