Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

# Animal Production & Health Newsletter

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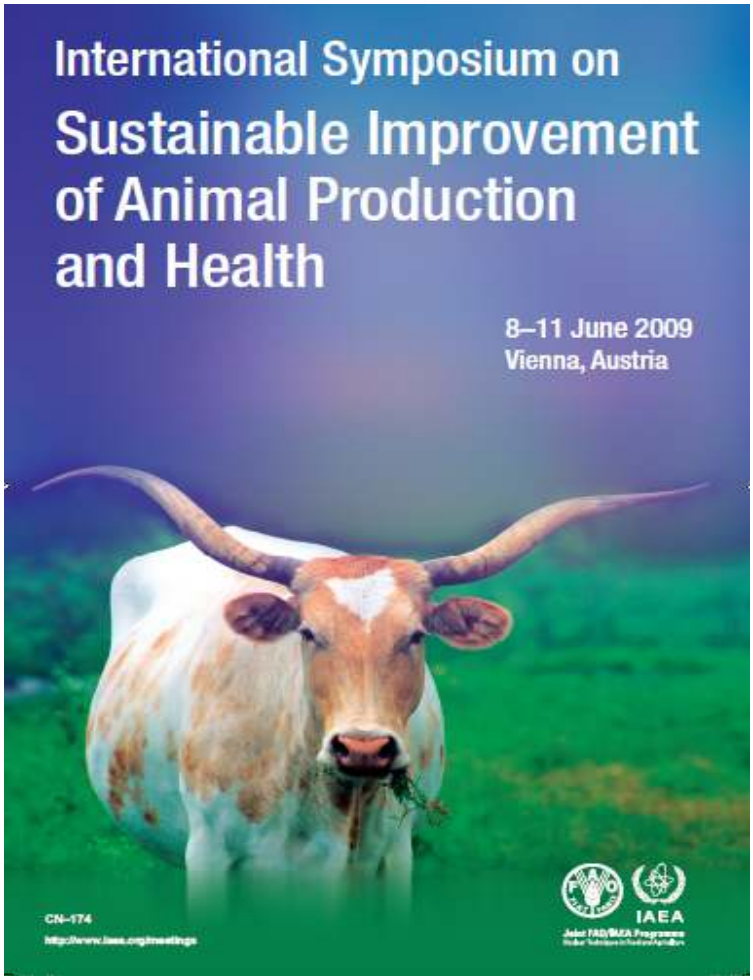



## To Our Readers

Dear Colleagues,

As informed in our previous newsletter we are in full motion in the organization of the main animal production and health event of 2009 of the Animal Production and Health Subprogramme, the 'International Symposium on Sustainable Improvement of Animal Production and Health' in Vienna, Austria, from 8 to 11 June 2009 (http://www-pub.iaea.org/MTCD/Meetings). The Symposium will address the early and rapid diagnosis and control methods for transboundary animal diseases including those of a zoonotic nature; improved reproduction technologies and breeding strategies; the efficient and sustainable use of locally available resources for animal production. Highly qualified international experts invited as keynote speakers in addition to oral and poster presentation from scientists and FAO/IAEA project counterparts from all over the world will make this event a milestone in the pursue of improved and sound technologies for enhancing food security and alleviating poverty. Please note and take action to ensure that you will participate in the Symposium. Be there or be square!

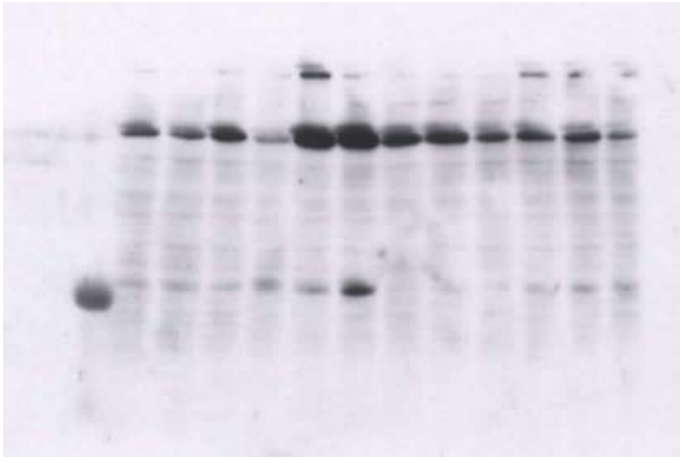
IAEA International Atomic Energy Agency

In this newsletter, I want to highlight some of the exciting new areas that we think will play an important role in the near future. It is true to say that the application of traditional nuclear and related technologies continues to play a specific and unique role in the quest to improve livestock production and to increase productivity to alleviate the global food crisis. Examples of these technologies are widespread, finding application in the fields of animal nutrition, breeding and health. Techniques utilizing isotopes of carbon, hydrogen, sulphur, phosphorus, or the stable isotope of nitrogen can be used to study the synthesis of animal feeds and pasture, the conversion and uptake of feed to nutrients, and utilization and role of rumen microbes in feed conversion. Selection of phenotypically desirable traits (e.g. leaner meat, increased milk production, disease tolerance) can be assisted by direct labelling of DNA to select for, or confirm, a selected genomic trait. Isotopic labels can also be used to determine an animal's parentage or origin, thereby providing confirmed traceability and enabling developing countries access to restricted markets such as Japan, the EU, and Canada. However, those applications that offer exciting possibilities for the future are the use of stable isotopes, irradiated vaccines, and radiation hybrid mapping.

Stable isotopes are nature's ecological recorders and are increasingly being used in animal production and health applications. The profile of 13C and 15N can provide accurate information as to the origin and breeding habitat of birds and their migratory routes - allowing risk assessment and prediction of the spread of a disease (e.g. Avian Influenza). Similar methods can be used to monitor the origin and distribution of feeds, reducing the risk of allowing contaminated feeds into the food chain. The role of wild birds in the spread of harmful diseases has to be further investigated. A number of isotopes can be useful in studying animal movement. Heavy isotopes (Sr, Pb) are representative of environmental processes and can be used to trace uptake from soils. The presence of light isotopes (C, N, S, O, H) in animal tissues depends on both biological and environmental processes. Studies are already in progress using stable isotopes to characterize (and differentiate) isotopic profiles amongst bird populations using 13C and 15N values in metabolically active tissues (blood and muscle), but presently, the most effective tracers are the hydrogen isotopes found in metabolically inert, seasonally grown tissues, such as feathers, bone and claws. Once the isotope profile of a particular bird population is known, any individuals from the population can provide information on global migration of that species. Global grids of hydrogen and oxygen water isotopes can be constructed using the data from the Global Network for Isotopes in Precipitation (GNIP) database collected by the IAEA and can then be compared to feather samples of migratory bird species in different overwintering locations. This will allow researchers to determine the location where feather growth occurred and thus trace the origin of birds found in the summer in Europe or North America.

The re-emergence of irradiated vaccines is exciting. The inactivation of pathogens by irradiation is gaining support since they stimulate the protective immune response in a similar way to an infection of the live organism. They mimic the immune induction pattern caused by live pathogens more completely than heat or chemically-treated organisms thus stimulating both arms of the immune system, i.e. the humoral or short-term protection via antibodies and the cellular or long-term protection via cellular memory. Not only this, the appearance of drug resistant organisms increases the need to seek alternative measures that can complement or even replace current practices for control of animal pathogens. Specifically for diseases such as Malaria, foot-and-mouth disease, *Fasciola* or *Neospora* in cattle, this opens a new approach to immunization as genetically engineered vaccines have not proven a major success. Recent studies have shown that where carefully administered doses of irradiation were used, alterations in the patterns of gene expression in the pathogen lead to enhanced immunogenicity. This opens up a whole new area of research into the as yet unidentified molecular mechanisms that are responsible for this altered immunogenicity. Such research could have potential advantages in dealing with metazoan parasites (i.e. helminths) where possibilities of eliciting immune responses that are specifically tuned to long-term immunity under natural challenge are important.

There is well documented evidence for breed and individual genetic differences in resistance to infectious diseases. An alternative approach to reduce the effect of endemic or infectious disease on animals is by identifying genetic markers associated with resistance to infectious diseases through the use of radiolabelled nucleotides in DNA hybridization, DNA characterization, and radiation hybrid (RH) mapping procedures.



*Autoradiograph of electrophoresis gel, S35 labeled* DNA *(courtesy of Ms M. Dolores Bargues)*

The acquisition of molecular genetic information of major livestock species is crucial in harnessing the benefits of genetic variation for economically important traits. This process is greatly facilitated by the ordering of molecular markers along selected chromosomes. RH mapping can be integrated with comparative gene mapping to enable identification of candidate genes for spe-

cific desirable traits as they provide precision in extrapolation of map position from one species to another.

Although considerable progress has been made with bovine genome sequencing, sheep and goat genome sequence data are still limited and there is an urgent need to identify and characterize those genes that are responsible for beneficial traits, not only to animal health but also those related to productivity and of specific relevance to the environments in which the animals occur. RH maps can be used to map genomic traits of disease resistance and those related to productivity such as growth, milk production, carcass quality and wool/hair quality. By investing in these technologies, together with assays utilizing 32P, 35S, Met-35S, and 125I to monitor productivity and reproduction in selected breeds and individuals, it will be possible to effect major changes in livestock by utilizing marker-assisted selection schemes to increase host resistance and productivity.

The harnessing of the information gained through nuclear and nuclear related techniques and its incorporation into mathematical modelling approaches, particularly those involving climatic change, is proving a powerful indirect tool for assessing animal husbandry and production requirements as well as disease patterns. This is particularly important since the influence of global warming is predicted to significantly alter the distribution of weather patterns with a concomitant affect on animal health and productivity. These technologies also provide for more informed and detailed information that allows quick and accurate tracking of disease, and provides improved tools for management/production decision-making.

Concerning news from the Subprogramme, we want to welcome Nicholas Odongo who joined us in August as Livestock Nutritionist. Prior to joining us, Nicholas was a visiting scientist at Agriculture and Agri-Food Canada in Lethbridge, Alberta, Canada, where he worked to develop recommendations for using fibre (peNDF) in dairy cow ration formulations to reduce the risk of ruminal acidosis in high-yielding dairy cows. We want to wish him well and look forward to his contributions to the Subprogramme. We said farewell to Tony Schlink who joined the Animal Production and Health Subprogramme from August 2007 for one year from Western Australia. We thank Tony for his tireless inputs and support, and his wealth of experience that he shared with us. We wish him, and his family, great success and happiness. We will remain in close contact and will continue to make use of his expertise.

We want to welcome all as members of the Subprogramme and wish them a pleasant and productive time with us.

Both past and future activities are described in detail in this Newsletter and are also accessible at our website (http://www-naweb.iaea.org/nafa/aph/index.html); I thus need not mention them in this section. Please contact us if you have any further ideas, comments, concerns or questions. As discussed in previous newsletters, the Animal Production and Health Subprogramme will continue to move progressively forward and in pace with developments within the livestock field, to optimally serve our Member States. Please, contact us in case you would like to receive printed copies of the Symposium flyer and poster for distribution in your institutes and universities.

Finally, I wish you all and your families a happy, healthy and safe New Year!

Gerrit Viljoen,
Head, Animal Production and Health Section

# Staff

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

# Forthcoming Events

## Consultants Meeting to Support the Accreditation of Veterinary Laboratories to OIE Standards and Pathways

Technical Officer: H. Unger

The meeting will be held from 10 to 12 December 2008 in Vienna, Austria.

The objective of this meeting is the compilation of background information for the design and technological needs for veterinary containment laboratories in order to produce a 'containment laboratory handbook'.

## Consultancy to Prepare Recommendations on the Use of Molecular Nuclear Techniques to Address Diagnosis and Epidemiology of Zoonotic Diseases

Technical Officer: H. Unger/ Baldip Khan

The meeting will be held from 15 to 17 December 2008 in Vienna, Austria.

Mr RPV Jayanthe Rajapakse, Department of Veterinary Pathobiology, Faculty of Veterinary Medicine & Animal Science, University of Peradeniya, Sri Lanka and Mr Wimal Abeyewickreme, Faculty of Medicine, University of Kelaniya, Sri Lanka, will prepare recommendations on the use of molecular nuclear techniques to address diagnosis and epidemiology of zoonotic diseases.

The aim if this consultancy is to produce recommendations under the vision of a 'One health / one diagnostic approach for humans & animals' and test these approaches in a combined project. The different diagnostic procedures used in these two disciplines lead to dificulties in the interpretation of data gathered. The paper produced should serve as a guideline for 'one health' projects and stimulate such cooperative projects.

## Coordination and Planning Meeting under RER5015

Technical Officer: G. Viljoen

The meeting will take place in Vienna, 26–30 January 2009.

The Coordination and Planning Meeting will review the current situation on Avian Influenza (AI) in the Europe region, to outline existing nuclear techniques for early warning and surveillance, and to formulate a strategy and a detailed implementation plan for the new technical cooperation programme RER5015 'Supporting Early Warning and Surveillance of Avian Influenza Infection in Wild and Domestic Birds and Assessing Genetic Markers for Bird Resistance' for 2009–2011.

## Consultant Meeting on Modelling and Predicting Animal Disease Dynamics as Impacted by Climatic Changes as a Basis for Preparedness Measures

Technical Officer: H. Unger

The meeting will be held from 16 to 17 February 2009 in Vienna, Austria.

It is generally accepted among experts that climate change will impact the spread of animal diseases including zoonoses. Detailed forecasts (Which disease? Where? When?) are impossible to make, though, and hence we are unable to conduct any specific prevention or preparedness measures as they would be needed to mitigate the risk of such diseases. FAO/IAEA through their Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, the Veterinary University of Vienna and the Swiss Agency for Development and Cooperation (SDC) have teamed up to kick-start an improvement of this situation by this consultant meeting. This meeting is a follow-up to the Joint ICTP-IAEA Conference on Predicting Disease Patterns According to Climate Changes in May 2008 in Trieste, Italy. As an outcome of the conference a few diseases were singled out as potential model diseases due to their impact on human and animal health and because sufficient data are apparently available to allow such an attempt.

The aims of this meeting are to get an overview on the state of science regarding the impact of climate change on the spread of animal diseases; to develop – through interdisciplinary dialogue – an understanding of why our ability to predict animal disease outbreaks as an effect of climate change is so limited; and to initiate a pilot project in an attempt to improve the situation.

This pilot project shall focus on Rift Valley fever (RVF) in Kenya. The RVF outbreaks in Kenya, United Republic of Tanzania and Sudan in 2006/7 not only created much suffering in these countries, but led for the first time to good data due to surveillance activities before, during and after the outbreaks. These outbreaks were 'predicted' by climatic models (US Department of Defence, Global Emerging Infections Surveillance and Response System), but this is not true for most of the alerts resulting from this system as it is only based on known endemic areas and does not take pathogen prevalence into account. A number of other models were developed, but the underlying epidemiological data were anecdotal and real time data were never integrated as it would have been required to allow for better accuracy.

For Bluetongue (BT) a number of models are now published after the ingression into central Europe and these models could be used as a raw model for RVF. We will gather and discuss all available RVF data from

Kenya, evaluate the access to weather data of this region for the given time and gain more insight into the existing models for RVF and BT. All this will help designing more realistic scenarios and prediction models. This should support defining factors for spread or limitation of infectious diseases, their vectors and influencing political and social factors. The resulting recommendations should be incorporated into existing networks (FP7, EDEN, CRP) and stimulate better cooperation between research organisations and affected countries.

## Regional Training Course on Molecular Epidemiology and Transmission of Fascioliasis RLA5049

Technical Officer: Gerrit Viljoen/Kathrin Schaten

The regional training course will be held in Montevideo, Uruguay, from 9 to 13 March 2009.

The purpose of the training course is to harmonize and implement the best approaches and tools for molecular epidemiology, diagnosis, control and prevention of Fascioliasis, including theoretical and practical training. To determine the epidemiological spread of the disease, by classical and new generation techniques and to identify areas at risk. Special attention will be given to molecular epidemiology and transmission of Fascioliasis. The course will be open to participants from Argentina, Cuba, Mexico, Panama, Peru, Uruguay, Bolivia and other Latin American Countries (e.g. Ecuador, Honduras and Belize) which are considered endemic with fascioliasis.

The training course is open to 20 participants from IAEA Member States in the region of Latin America and the Caribbean.

The training course consists of lectures and practical experiments. This will consist of presentations by experts and other consultants from local and participating countries with the aim to identify the main areas on interest (e g. harmonized protocols and procedures for sample collection, extraction and diagnostic procedures, test analysis and result interpretation) within the frame of quality management activities and the implementation of appropriate technologies.

## Research Coordination Meeting on Development and Use of Rumen Molecular Techniques for Predicting and Enhancing Livestock Productivity 2003–2009 D3.10.24

Technical Officer: E. Nicholas Odongo

The final RCM will be held at the Vienna International Centre in Veinna, Austria, from 8 to 13 June 2009.

The RCM will (a) review the research results obtained by each contract holder; (b) assess the achievements, outputs and potential outcomes; (c) draw conclusions and make recommendations; (d) list the activities that should be continued using national and/or other resources; and (e) prepare the scientific papers from the project for publication.

## Research Coordination Meeting on Gene-based Technologies in Livestock Breeding: Characterization of Small Ruminant Genetic Resources in Asia 2005–2009 D3.10.25

Technical Officer: Mario Garcia

The final RCM will be held at the Vienna International Centre, from 8 to 13 June 2009, in conjunction with the International Symposium on Sustainable Improvement of Animal Production and Health. Research, Agreement and Technical Contract holders will present and discuss the final reports.

## Research Coordination Meeting on Veterinary Surveillance of Rift Valley Fever 2005–2009 D3.20.23

Technical Officer: Gerrit Viljoen

The final RCM will be held at the Vienna International Centre, from 8 to 13 June 2009, in conjunction with the International Symposium on Sustainable Improvement of Animal Production and Health. Research, Agreement and Technical Contract holders will present and discuss the final reports.

## International Symposium on Sustainable Improvement of Animal Production and Health

Technical Officers: Gerrit Viljoen/Kathrin Schaten

The International Symposium will be held from 8 to 11 June 2009 in Vienna, Austria.

### 1. BACKGROUND

The on-going 'Livestock Revolution', a demand-driven increase in livestock production, especially in developing countries, presents both opportunities and risks. The shift in the human diet from plant-based protein sources to animal-based protein sources, consumer demand for safe and quality animal products, and expanding markets for livestock products have raised several challenges such as; cost-effective production of safe and quality animal products, control of emerging and zoonotic diseases, and efficient management of impact of livestock on the environment. However, these changes have also provided many opportunities to benefit the local economy and producers, and reduce poverty. New challenges and opportunities demand innovative ideas and approaches, and mechanisms to take this knowledge to potential users. Many of the approaches will be multidisciplinary in nature and require collaboration with specialists in areas other than animal scientists.

Livestock production in developing countries is constrained by low genetic potential of animals, poor

nutrition, poor husbandry and infectious diseases. Nuclear techniques, when applied in conjunction with conventional methods, can identify critical points in these areas that can be targeted for cost-effective improvements and interventions. Thus the challenge is to use such technologies to enhance food security and alleviate poverty by supporting sustainable livestock production systems in developing countries through strategic and applied research, technology transfer and capacity building.

## 2. MAIN TOPICS

- Interactions among nutrition, reproduction and genotype
- Livestock-environment interaction / productivity/ climate ( water/ land/ plants/ heat/ altitude)
- Detection and control of transboundary animal diseases, including zoonoses
- Animal product safety and food quality

## 3. TARGET AUDIENCE

- Scientists from developing and developed countries
- Policy makers — Governmental and International Organizations
- Donor agencies — International/National Organizations, International/National Foundations and Trusts

## 4. EXHIBITS

Limited space will be available for commercial vendors' displays/exhibits during the symposium. Interested parties should contact Ms. Kathrin Schaten, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture IAEA, at email: K.M.Schaten@iaea.org

## 5. CONTRIBUTED PAPERS AND POSTERS

Concise papers on issues falling within the topics outlined in Section 2 above may be submitted as contributions to the symposium.

**(a) Submission of synopses**

Persons who wish to present a paper or poster at the symposium must submit an extended synopsis (in English) of 800 words maximum (i.e. two A4 format pages of single spaced typing or the equivalent, including any tables or diagrams and a few pertinent references) on one of the topics listed under Section 2. The extended synopsis should be submitted together with the completed Form for Submission of a Paper/Poster (Form B), and the Participation Form (Form A) to the competent national authority for official transmission to the IAEA in time for them to be received by the IAEA by 15 December 2008. In addition, the synopsis must be sent electronically to the IAEA scientific secretariat, email: APHS-Symposium2009@iaea.org

Authors are urged to make use of the Synopsis Template in Word on the symposium web page (see Section 15). The synopsis should give enough information on the contents of the proposed paper to enable the selection committee to evaluate it. Introductory and general matters should not be included. The synopsis — if accepted — will be reproduced in unedited form in the Book of Extended Synopses; the original must therefore be submitted as a camera-ready copy in a form in which the author will wish to have the work presented.

**(b) Acceptance of Papers for Oral Presentation and Poster Presentation**

Given the number of papers anticipated and the need to provide ample time for discussion, the number of papers that can be accepted for oral presentation is limited. Authors who would prefer to present their papers in a poster session are requested to indicate this preference on Form A with which they send the extended synopsis.

Authors will be informed whether their papers/posters have been accepted for presentation on the basis of the extended synopsis. Guidelines for the preparation of the papers and the deadlines for their submission will be provided at that time.

The IAEA reserves the right to decline to present or publish any paper that does not meet expectations based on the information in the extended synopsis.

Further details about the preparation of papers and oral presentation at the symposium will be sent to the authors of the papers accepted together with notification of acceptance.

## 6. EXPENDITURES

No registration fee is charged to participants.

As a general rule, the IAEA does not pay the cost of attendance, i.e. travel and living expenses, of participants. However, limited funds are available to help meet the cost of attendance of selected specialists mainly from developing countries with low economic resources. The grants awarded will be in the form of lump sums usually covering only part of the cost of attendance. Generally, not more than one grant will be awarded to any one country.

If governments wish to apply for a grant on behalf of one of their specialists, they should address specific requests to the IAEA to this effect. Governments should ensure that applications for grants are submitted by 15 December 2008 and are accompanied by a duly completed and signed Grant Application Form. Applications that do not comply with these conditions cannot be considered.

## 7. SYMPOSIUM PROCEEDINGS

The proceedings of the meeting will be published by the IAEA as soon as possible after the symposium.

## 8. DISTRIBUTION OF DOCUMENTS

A preliminary programme of the symposium will be sent to participants in advance. The final programme and the book of extended synopses will be distributed at registration.

## 9. WORKING LANGUAGE

The working language of the symposium will be English.

## 10. PARTICIPATION

All persons wishing to participate in the symposium are requested to register in advance online. In addition they must send a completed Participation Form (Form A) and if relevant, the Form for the Submission of a Paper (Form B) and the Grant Application Form (Form C) through the competent official authority (Ministry of Foreign Affairs, Ministry of Agriculture, national FAO committee (FAO Country Representative, the relevant Regional or sub-Regional FAO Office), or the National Atomic Energy Authority) to the IAEA. A participant will be accepted only if the Participation Form is transmitted through the government of a Member State of the Sponsoring Organizations or by an organization invited to participate.
Participants whose official submissions have been received by the IAEA will receive further information on the symposium approximately three months before the meeting. This information will also be posted on the symposium web page.

## 11. ACCOMMODATION

Detailed information on accommodation and other symposium related information will be sent to all designated participants well in advance of the symposium. This information will also be available on the symposium website.

## 12. VISA

Designated participants who require a visa to enter Austria (Schengen State) should submit the necessary applications to the nearest diplomatic or consular representative of Austria or any other consular authority of a Schengen partner State representing Austria as early as possible (please note that it could take up to three weeks to obtain a visa).

## 13. CHANNELS OF COMMUNICATION

The Participation Form and as applicable, the Form for Submission of a Paper/Poster, and the Grant Application Form, should be sent to the competent national authority (Ministry of Foreign Affairs, Ministry of Agriculture, national FAO committee, or national atomic energy authority) for official transmission to the IAEA.
Subsequent correspondence on scientific matters should be sent to the Scientific Secretary and correspondence on administrative matters to the IAEA Conference Services Section.

## 14. SYMPOSIUM SECRETARIAT

The address of the Secretariat is:
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## 15. SYMPOSIUM WEB PAGE

Please visit the IAEA symposium web page regularly for new information regarding this symposium:
http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=35424

# Regional Training Course on the Diagnosis of Avian Influenza (AI), Europe

Technical Officer: Gerrit Viljoen
The meeting will be held from 22 September to 2 October 2009 at Seibersdorf, Austria.
The purpose of the meeting will be to enhance knowledge and to provide practical training on current techniques for the rapid and sensitive diagnosis of avian influenza, focussing on nuclear and nuclear-related aspects.

# Regional Training Course on Clinical Pathological Molecular Technologies of Animal and Human Fasciolosis and the Treatment and Measures of Control RLA5049

Technical Officer: Gerrit Viljoen/Kathrin Schaten
The regional training course will be held in La Paz, Bolivia, from 16 to 20 November 2009.
The purpose of the training course is to harmonize and implement the best approaches and tools for molecular epidemiology, diagnosis, control and prevention of Fascioliasis, including theoretical and practical training and to determine the epidemiological spread of the disease, by classical and new generation techniques, and to identify areas at risk. Special attention will be given to clinical pathological molecular technologies and the treatment and measures of control.
The course will be open to participants from Argentina, Cuba, Mexico, Panama, Peru, Uruguay, Bolivia and other Latin American Countries (e.g. Ecuador, Honduras, Venezuela and Guatemala) which are considered endemic with fascioliasis.

This course is intended for participants with an academic background equivalent to a Bachelor's degree in veterinary, animal, human or biological science, and with experience in molecular biology techniques. Participants must be actively involved in the diagnosis and control of fascioliasis. Participating countries are encouraged to submit more than one application.

# Announcements from Member States

## International Meeting on Emerging Diseases and Surveillance (IMED 2009)

The meeting will take place from 13 to 16 February 2009, Hotel Hilton, Vienna, Austria.

Emerging infectious diseases are at the center of the world's attention. The threats of pandemic influenza and bioterrorism, and the realization that new infectious diseases may be recognized at any time, in any place, have dramatically raised our awareness. What are the most important emerging disease threats? How can we quickly detect their occurrences in order to respond in a timely and appropriate way?

ProMED, the Program for Monitoring Emerging Diseases, is pleased to invite you to the International Meeting on Emerging Diseases and Surveillance 2009. Along with our cosponsors, the European Centers for Disease Control, the World Organization for Animal Health, the European Commission, and the Wildlife Conservation Society, we are developing a conference that will bring together the public health community, scientists, health care workers and other leaders in the field of emerging infectious diseases.The meeting will embrace the 'One Medicine, One Health' concept recognizing that, just as diseases reach across national boundaries, so do they transcend species barriers.We therefore welcome the full participation of both the human and animal health communities.

Full information can be received from the address: http://imed.isid.org/.

# Past Events

## National Training Course on Diagnosis of Brucellosis SUD5031

Technical Officer: Hermann Unger

The Training Course took place from 1 to 11 June 2008 in Khartoum, Sudan.

This national training course provided basic training in the diagnosis of Brucella.

Sudan is a major exporter of animals and animal products and increased the efforts to control Brucellosis to meet the market needs. For the animal export, new measures for diagnosis of Brucella antibodies are under evaluation. In order to perform these tests in a quality assured way in the different laboratories, a training course for veterinarians was organized and IAEA supported this technical cooperation project with the necessary reagents, test kits and an expert lecturer Dr I. Naletoski.

Thirty three veterinarians from 8 Veterinary Research Laboratories in Sudan attended the training course.

A national conference held on the first day on problems related to Brucellosis in Sudan was well attended by officials from the Ministry of Science, National Atomic Energy Agency and responsible personnel for import and export issues. The expert presented a lecture on 'Principles for controlling and eradicating Brucellosis'.

The training on Brucella diagnosis started the next day comparing the performance and technical issues for the Rose Bengal test, serum agglutination test and indirect and competitive ELISA. During the training, the participants tested 936 cattle samples, 789 sheep/goat samples and 779 camel samples. All samples were tested using all the above mentioned methods.

After the testing, all results were matched to determine the 'between tests agreement'. This was done to demonstrate the trainees that the tests perform differently, according to their analytical and diagnostic performances. The relative, between test sensitivity and specificity were also calculated to demonstrate the chance of missing positive or negative results, when a single test is used.

The training provided was seen as very helpful for deciding which diagnostic procedures to be carried out for a given purpose, i.e. eradication, control or export certification. Eighteen participants were further trained by staff from the Soba laboratory after the course in order to establish standard procedures for Sudan.

## Regional Training Course on the Molecular Diagnosis and Control of Animal Fascioliasis in the Latin America Region RLA5049

Technical Officer: Gerrit Viljoen

The Regional Training Course on the Molecular Diagnosis and Control of Animal Fascioliasis in the Latin American Region – with special focus on the molecular characterization of liver flukes (under TC Project RLA5049 – Integrated control of fascioliasis in Latin America) took place from 22 to 28 June 2008 in Puebla, Mexico.

This theoretical and practical orientated training course on the molecular characterization of liver flukes (fascioliasis) is the second in a series of five planned training courses to address the Latin American regional constraints in the diagnosis, control, characterization and epidemiological spread of fascioliasis and its snail hosts. The course focussed on the transfer of nuclear and nuclear related molecular technologies to laboratory supervisors (train the trainers) and laboratory technicians, in particular harmonization of these technologies, practical hands-on bench-work and addressing the issues that may arise with this disease. Each theoretical session was followed by a practical session to ensure the practical proficiency of the participants. Discussions revealed a pronounced heterogeneity of scientific knowledge, information and data available about the molecular characteristics of liver flukes in the different countries, including several countries in which some baseline studies still had to be undertaken with tools appropriate to ascertain the current situation.

The training course was attended by 26 regional fascioliasis diagnosticians, including 6 of the 7 national counterparts of project RLA5049 from Panama, Cuba, Ecuador, Bolivia, Uruguay, Argentina, Venezuela, Honduras, Peru, Mexico, Spain and Austria. The training course was hosted by the Universidad Autónoma de Puebla, and the Universidad Mesoamericana de Puebla, Mexico. The opening addresses (Monday 23 June) were delivered by the Rector of the Universidad Autónoma de Puebla (Prof Enrique Aguera Ibanez) and the reporting officer. Prof Salvador Calva Morales, Rector of the Universidad Mesoamerican, welcomed the participants to his University on Thursday morning (26 June).

The first day of the training course was devoted to reviewing the current scientific knowledge of the disease, the contribution liver flukes play in the disease cycle between hosts and targets, and possible approaches and solutions. The reporting officer made a presentation on technology transfer, the empowerment of Member State scientists to reduce poverty and to increase their livelihoods, the IAEA's role and expectations of the project, and the likely outcomes that can be expected from the project. This talk was followed by presentations of technical reviews from the reporting officer and other lecturers - Dr Santiago Mas-Coma, Dr Maria Dolores Bargues, Dr Mineko Shibayama and Dr Raul Rojas Garcia. The reviews presented were followed by theoretical and practical sessions according to the detailed training course agenda. The areas discussed with regard to molecular characterization of liver flukes included:

- Assessing the opportunistic occurrence and growth of human and animal fascioliasis, and its alarming rise of incidence in woman and especially children younger than 5 years of age — disease control should be focussed at the point of entry, i.e. the animal host.
- Increase in disease susceptibility (i.e. secondary infections) when animals are infected with fascioliasis and its debilitating effect on animal production.
- Evaluation, validation and harmonization of nuclear and nuclear related molecular biological technologies such as host snail and liver fluke genome mining and analysis, primer and marker tracing, and characterization criteria (e.g. ITS primers sites).
- Molecular genetic analysis and interpretation (phylogenetic and proteomic analysis).
- Validation and implementation of an on-site diagnostic test.
- Training, equipment and reagent needs.

Discussions revealed a pronounced heterogeneity of scientific knowledge, information and data available about the characteristics of the disease in the different countries, including several countries in which some baseline studies still have to be undertaken with tools appropriate to ascertain the current situation. Information presented suggests an urgent need to implement international and national intervention activities to establish the appropriate control and prediction measures. Because livestock plays such an important role in the cycle of this disease, and to establish a foothold on the disease, fascioliasis should be addressed first at the source (i.e. at the animal level), with human fascioliasis to follow (the one will, however, not exclude the other). Diagnostic, prophylactic and infection treatments, surveillance and epidemiological characterization methods utilizing appropriate tools should be evaluated, validated and implemented in endemic countries without delay. Conclusions reached about this zoonoses clearly indicate that the complexity of the disease requires multidisciplinary cooperation between national agencies responsible for public health, food and agriculture, science and technology experts, and the education sector. The very high spreading capacity of this disease requires the establishment of international cooperation efforts between neighbouring countries, as well as international organisations such as WHO, PAHO, FAO, IAEA, and the private sector (prophylactic treatment).

The transboundary spreading capacity of this disease, the problems posed by the non-controlled export and import of livestock, the risk of drug resistance appearance and its expansion, the great heterogeneity of

knowledge evident in neighbouring countries and other related aspects were discussed in detail.
The following training courses were suggested as follow-up and continuation of the preceding two fascioliasis training courses in Peru and Mexico: (1) 'Applied Malacology of Fascioliasis and Molecular Biology of Lymnaeid Vectors training course' to be organized by Dr Lazara Rojas in Havana, Cuba (Nov 2008), (2) 'Molecular Epidemiology and transmission of Fascioliasis training course' to be organized by Dr Valeria Gayo in Montevideo, Uruguay (March 2009), and (3) 'Clinical pathological molecular technologies of animal and human fascioliasis and the treatment and measures of control training course' to be arranged by Dr Rene Angles and Dr Eddy Martinez, in La Paz, Bolivia, (in 2009 - combined end of project meeting and training course).

## Consultants Meeting to Screen Plants and/or Plant Products for Impact on Animal Production, Health and the Environment

Technical Officer: E. Nicholas Odongo
The consultants meeting took place from 14 to 17 July 2008, in Vienna, Austria.

The global demand for animal protein is expanding rapidly with changing life styles and improved incomes. However, the increased competition from crops to supply basic food stocks for the animals has resulted in the increased intensification of livestock production systems. Furthermore, it is foreseen that the expansion of the livestock sector will mostly take place in developing countries. This intensification of livestock production can lead to higher levels of greenhouse gas emissions, competition for food and feed resources, localization and/or concentration of nutrients, pollution of water resources, and increased use of chemicals and drugs to combat animal diseases. On the other hand, global pressure is mounting from consumers and consumer groups for farmers to engage in sustainable production systems where safe and high quality food and food products are produced efficiently with minimal impact on the environment and human health.
Six experts in plant secondary compounds, ruminant nutrition and aquaculture from agricultural research organisations, universities in Australia, Spain, Tunisia, and USA, an FAO representative along with IAEA representatives attended a 4-day meeting to address the question "To what extent can plants resources with secondary compounds be used to improve livestock productivity and health while maintaining environmental health and plant diversity in developing countries?". The consultants recognized the comparative advantage that the Joint FAO/IAEA Division had in coordinating research programmes (CRP). They recommended that the Joint Division should consider initiating a new CRP on the 'Bioactive plants and plant products to improve productivity and health of ruminants in developing countries'. Such an initiative was strongly supported by the growing need to reduce the use of chemicals and antibiotics in ruminant production and the need to reduce the impact livestock has on the environment. It was recognized that the initiative would build on the expertise already developed in active and completed IAEA supported projects. The overall objective of the CRP would be to screen a limited number of candidate local plants for activity against enteric methane production and helminths. Upon identification of candidate species, further sampling within the species would follow to determine within species variation and to measure the environmental effects of the bioactivities. The short-listed candidate species would then be evaluated *in vivo*.
The consultants also recognized the importance these bioactive plants and plant products had for other animal species and recommended the Joint Division consider initiating a CRP on the 'Identification of underutilized plants and plant products to improve fish productivity and health'. The consultants noted that the rise in aquaculture production, coupled with increased pressure on the industry to move away from fishmeal as the primary source of protein in formulated diets was a good justification for considering moving to plant based protein sources including the screening of both conventional and non-conventional plant sources for nutritional, health and anti-nutritional activity. The first phase of screening would include proximate analyses, amino acid and fatty acid profiling followed by *in vivo* evaluations. This CRP would diversify the research capacity in developing countries by expanding the skills already developed for land species to address issues in aquaculture. A review of the literature could also be commissioned in the area of 'Phytochemical methods for the screening of bioactive components in plants' and the reviews presented in the form of a book.

## Regional (AFRA) Training Course on Follow-up on Reproductive Performance and Production in AI Females and their Calves RAF5054

Technical Officer: Mario García Podestá

This regional training course was part of the activities of the Regional Technical Cooperation Project RAF/5/054 on 'Improvement of Livestock Productivity through an Integrated Application of Technologies (AFRA III-4)'. The course aimed to provide training on farm data recording and data management, assessing of reproductive status and productive parameters, improved breeding technologies, and selection of AI sires and bull mothers. The course was hosted by the Department of Agricultural Research (DAR), Ministry of Agriculture, Botswana, from 1 to 5 September 2008.

Twenty applicants from 15 AFRA Member States (Algeria, Burkina Faso, Cameroon, Central African Republic, Egypt, Ethiopia, Ghana, Kenya, Madagascar, Niger, Nigeria, Sudan, Tunisia, Zambia, and Zimbabwe) plus three local professionals were invited to participate. The course Director was Mr Thobo Babwasi and the resource persons were Prof. Naceur Slimane (École Nationale de Médecine Vétérinaire - ENMV, Sidi Thabet, Tunisia), Dr Douglas Indetie (Kenya Agricultural Research Institute - KARI, Lanet Research Center, Kenya), and the Technical Officer of the project Mr Mario García. The opening session was addressed by Dr Seja Gasenone Maphanyane, Director of the Department of Agricultural Research.

The training course covered the following topics:

- Methods for the identification of animals
- Farm data recording and data management
- Assessing reproductive status and diagnosis of disorders
- Assessing production parameters
- Breeding techniques and selection of breeding animals
- FAO/IAEA computer applications for AI and farm management.

The course consisted in morning lectures and afternoon practical sessions. It was held on the premises of DAR and some of the practicals were conducted in the experimental dairy farm located in the outskirts of the capital. Some course participants had ample experience on the use of AI so their contributions enriched the presentations and stirred up the discussions.

A field visit was made to a private farm where Holstein and Jersey cows and crosses with indigenous breeds were reared, and to the national artificial insemination centre, both located in the Lobatse area. Fruitful discussions and exchange of experiences were held between course participants and the professionals in charge.

The host institute provided excellent facilities for the training course. The closing session of the course was addressed by Chief Agricultural Research Officers Dr Pharoah O.P. Mosupi and Dr Wameotsile Mahabile, and Director of Research and AFRA National Coordinator Ms Lesego M. Motoma.

Course participants were highly motivated and eager to participate in all course activities, especially in the practical sessions where additional hours were spent on their request.

The objectives of the training course were successfully achieved.

The resource persons had excellent contributions, based on their expertise and knowledge, to fulfill the objectives of the course and to stimulate fruitful discussions on the topics covered in the training course.

Great differences exists among countries on the quality of artificial insemination services, extent of field data collection, level of data interpretation, awareness on the potential and disadvantages of importing semen and embryos of exotic breeds, use of local breeds, and selection criteria of AI sires and bull mothers.

Technical backstopping on the use of the computer applications distributed to course participants will be sustained by the Animal Production and Health Section to ensure better results in support of AI services, bull stations, and farm management.

## Regional Training Course on the Diagnosis of Avian Influenza (AI), Europe

Technical Officer: Gerrit Viljoen

The regional training course on avian influenza for the European region was held in Vladimir, Russia from 15 to 26 September 2008.

Early detection of pathogens and the timely warning of outbreaks with the capacity to predict spread to new areas are essential pre-requisites for the effective containment and control of epidemic transboundary animal diseases (TADs), including zoonoses. Weaknesses of disease surveillance systems (diagnostics and epidemiology) and the inability to react in a timely manner to control major diseases such as foot-and-mouth disease, Rift Valley fever, Bluetongue and avian influenza at their source have contributed to their spread across geographical borders. The early and rapid detection of pathogens does not only reduce response time but also allows for the treatment at source before the disease has spread.

The FAO/IAEA training course supported by FAO, EU-ConFluTech, OFFLU-IZSVe and CIRAD-EMVT, was hosted by the Federal Centre for Animal Health (FGI-ARRIAH) in Vladimir, Russian Federation. It was attended by avian influenza diagnostic technicians and laboratory personnel from 16 European countries. This constituted 23 participants, 5 lecturers and 5 laboratory technicians. Several scientific talks were also provided by invited and guest experts. Several interviews were held with local and regional newspapers to explain the purpose, background and expected outputs of the European regional training course.

The participants to the course were selected primarily on the basis of their country's risk to avian influenza (where highly pathogenic avian influenza is already endemic, recently introduced, or neighboring an infected country, or are on the flight path(s) of migratory birds that could be transmitting the disease) and on their laboratory's proficiency.

Highly pathogenic avian influenza (HPAI) subtype H5N1 re-emerged in 2003 in Asia and from there

spread rapidly to Europe and Africa. The H5N1 avian influenza subtype holds a potential human pandemic risk since; it is a highly infectious and dynamically evolving disease that spreads rapidly and widely across countries and continents due to the migration routes of carrier avian species, especially water and predator birds; it is zoonotic in nature causing a high rate of mortality in both birds and humans (from the reported 385 human cases, 245 resulted in fatalities, i.e. a mortality rate of about 65%); it threatens national, regional and international trade on poultry and poultry products as a consequence of quarantine regulations; it threatens food security and the livelihood of many millions of poor farmers; the control of it is beyond the scope and resources of a single country or region.

The IAEA, and FAO through its EMPRES programme, have assisted Members States by providing information (laboratory infrastructure, equipment, reagent and consumable needs), diagnostic laboratory guidelines, standard operating procedures for diagnostic tests and training on the use of vaccines and appropriate diagnostic tests. The technical based intervention by the IAEA has prepared Member States to react to disease events in a timely manner. This action has however, to be followed-up and indeed expanded. To control transboundary infectious diseases effectively (case in point avian influenza) the early, rapid, sensitive and specific detection of a harmful introduction is critical as this impacts on the speed of implementation of control measures such as movement and trade restrictions, the possible implementation of a ring vaccination programme and quarantine/stamping-out/culling strategies in infected areas. Unfortunately, inadequate capacity in many countries is the principal limiting factor for implementing an effective control or even eradicating policy and therefore the building up (or the enhancement of an existing capability) is critical and calls for a consolidation of international effort.

The content of the course was aimed at enhancing trainees' knowledge on the use of highly specific and rapid molecular techniques for the diagnosis, identification and characterization of HPAI viruses. The course focused on the RNA purification and cDNA transcription of the viral RNA, the nucleic acid amplification approaches (both classical [PCR] and real-time or quantitative PCR [Realtime-PCR and QPCR]), and gene sequencing for unequivocally identification, differentiation (H5/H7/H9 and N1/N3/N9), and characterization of HPAI viruses with special emphasis on the zoonotic sub-type H5N1. Trainees also received quality management and PCR laboratory set-up guidelines, sampling frame guidelines, procedures for submitting samples to OIE/FAO reference laboratories, and they were updated on the epidemiology of highly pathogenic avian influenza. They were furthermore, informed of the different activities of not only FAO and IAEA (on the control of important transboundary animal diseases and particularly avian influenza), but also that of WHO and OIE. Particular emphasis was made of OFFLU, the OIE-FAO Network on avian influenza that has the mandate to:

- Offer veterinary expertise to Member States to assist in the control of avian influenza (AI)
- Share biological material and data
- Develop research on AI
- Collaborate with the WHO Influenza Network on the animal-human interface.

The design of the course facilitated the transfer of molecular diagnostic approaches and techniques to developing country diagnosticians to enable them to improve their skills, laboratory capabilities and control strategies at all levels from basic to complicated platforms. The topics covered and discussed included an overview of the methods used in molecular diagnostic analysis with theoretical lectures supported by practical demonstrations and hands-on experience of appropriate techniques; instructions on application of relevant guidelines and quality assurance systems (ISO 17025 and FAO/IAEA quality standards and guidelines); molecular diagnostic laboratory accreditation, control strategies and related legislation topics. Several interviews were held with local and regional newspapers to explain the purpose, background and planned outputs of the European regional training course.

The Federal Centre for Animal Health (FGI-ARRIAH) in Vladimir, Russian Federation, was a suitable venue for the training course as all their staff has extensive practical experience with the diagnosis and control of Highly Pathogenic avian influenza sub-types H5, H7 and H9. In addition, the FGI-ARRIAH avian influenza laboratory is involved in an OIE Twinning programme with the Avian Influenza OFFLU reference centre in Padova, Italy.

There was a general consensus that IAEA and FAO Member State diagnostic laboratories should be prepared to conduct a quality assured diagnostic service before the onset of disease or to exercise appropriate control measures during an outbreak. For this purpose, early, rapid and sensitive molecular diagnostics and quality assured strategies are two of the most important components with regards to food security, preparedness, increased livelihood, improved trade and the alleviation of poverty. A strategy for making continual veterinary health improvements (including trained and competent personnel, adequate infrastructure and national governmental support) is essential in developing countries and the importance and impact of this control strategy on both internal and external markets for animal-derived food commodities will continue to increase. The molecular diagnostic training course is therefore, timely and of great value.

There is a great demand from IAEA and FAO Member States for training in the various aspects of nuclear and nuclear related molecular diagnostic methodologies, activities and technical support due to the fact that it allows the testing laboratories to detect and report the presence of a harmful pathogen in a quality assured and timely manner.

It is recommended that further "continuing or ongoing or refresher training courses or sessions" be held to address specific aspects in more detail to assist national/regional animal health control strategies and programmes – with special reference to emerging and re-emerging transboundary animal diseases and those of zoonotic nature such as avian influenza. Participants requested follow-up and refresher molecular diagnostic courses as part of the IAEA's technology transfer and continued education activities.

Subjects identified include sampling frames, sample preparation (extraction and clean-up), screening and detection methods (both on-site and laboratory analysis), standard operating procedures (SOPs), laboratory quality assurance and accreditation programmes (ISO 17025 criteria), result evaluation, interpretation and reporting and action guidelines.

The rapid and early detection of emerging and re-emerging transboundary animal diseases will result in a timely and effective disease control response that will be proactively cost effective 'prevention is better than cure' in that it will save animal and human lives and limit emergency capital outlay.

There is growing interest and demand for isotopic and nuclear techniques due to the development of genetic and nucleotide sequence analyses and the increased demand for a higher level of detection sensitivity (e.g. to identify and characterize carrier status animals). This is particularly important in the non-invasive tracing of movement and migration of wild birds with stable isotopes.

The training courses held so far and planned are:

- Interregional Training course from 20 November to 1 December 2006 in Seibersdorf, Austria
- Regional Training Course for Africa from 26 August to 1 September 2007, Cairo, Egypt
- Regional Training Course for Asia from 19 to 30 November 2007, Geelong, Australia
- Regional Training Course for Europe from 15 to 26 September 2008 Vladimir, Russia
- Regional Training Course for Europe from 22 September to 2 October 2009, Seibersdorf, Austria.

## Pan African Conference 'A Centenary Celebration of the Founding of Onderstepoort, Focusing on the Impact of Animal Diseases on Food Security and the Economic Development of Africa'

Technical Officer: Gerrit Viljoen

APHS is cooperating in the conference, which was held from 7 to 9 October 2008 in Pretoria, South Africa.

In 1908 a Pan-African Veterinary Conference formed part of the inauguration ceremony of the Onderstepoort Veterinary Laboratory. It was the first of a series of similar conferences held in different African countries during the first half of the 20th century. It was therefore fitting that the centenary celebrations of the Onderstepoort complex in 2008, and the celebrations of the imminent rinderpest eradication declaration (expected in 2010), should again be accompanied by a Pan-African meeting of those involved in combating animal diseases, and those that threaten human health, on the continent. The intention was to celebrate accomplishments of the past but also to look into the future and plan the 'African' way forward. The focus of the meeting was on research achievements and needs. Special consideration was given to sustainable transfer of technologies, reference and training institutions, training and continuous education of veterinary field service staff, and the role of technological developments such as the design and production of vaccines and the appropriate use of diagnostic procedures and tools.

The sessions were scheduled to highlight the historical contributions of the Southern African Veterinary diagnostic services over the past 100 years towards the diagnostics and control of animal diseases and those that threat human lives in the SADC (South African Development Community) and African regions. A summary of the proceedings, with abstracts of the centenary presentations, is available at the Animal Production and Health Section. Detailed proceedings, in the form of a publication, will be available at a later stage. The topics included the historic role of the veterinary service to ensure the improvement of human livelihoods (food security); the control of rinderpest (its eradication declaration is due for 2010), botulism, contagious bovine pleuropneumonia, and poisonous plants: the role of tsetse and animal and human trypanosomosis; control of Theileriosis in Sub-Saharan Africa; elimination of heartwater, African Swine fever, African horsesickness, and Bluetongue; the role of veterinary field services; veterinary education in Africa; the role of international organizations; the facilitation of international trade in animals and animal products; and the sustainability of food and agriculture production in Africa.

Each session dealt with the factors associated with quality assurance and management of veterinary health laboratories, the quality assured diagnosis of transboundary animal diseases, the appropriate action to be taken (and their sequential process), and the way forward and the challenges faced. It was clear that the present food crisis and the shortage of agricultural products will dominate the agenda for the foreseeable future (being presented as first even before the present economic and energy crisis).

The meeting was to commemorate 100 years of veterinary achievements in Africa, in particular the achievements of its oldest fraternity, the Onderstepoort Veterinary Institute in South Africa, to map out the way forward to ensure the sustainable intensification of animal production, and to provide secure animal food for the future. This would entail competent diagnostic services and appropriate prophylactic (vaccine and treatment) programmes.

Of importance are the quality assured diagnosis of animal diseases (and those that threat human lives), and the provision of locally based diagnostic laboratories to provide quality diagnostic services capable of identifying a disease before the onset of such disease.
The general conclusion for all sessions was that classical, serological and molecular veterinary diagnostics, and quality assured strategies are the most important components with regards to food security, preparedness, increased livelihood, improved trade and the alleviation of poverty. A strategy for making continual improvements to the controls on veterinary health (including trained and competent personnel, adequate infrastructure, and national governmental support) is essential in developing countries, and therefore the importance and impact of this control strategy on both internal and external markets for animal-derived food commodities will continue to increase.
A 100% increase in livestock numbers in Africa would relate in a 20% Agricultural Production improvement and an increase of 4.5 billion USD net profit for Africa.
Food and Agriculture is the biggest work and sustenance provider in Africa. It therefore contains the highest spot in the fight of Africa to improve its poverty figures. Of a total of about 900 million people in Africa, it was estimated that about 500 million people are indirectly or informally involved in the production of food and agriculture.
There is a great demand from IAEA and FAO Member States for training in the various aspects of veterinary diagnostic methodologies, activities, and technical support. The FAO/IAEA co-sponsored a molecular diagnostic regional African course that currently run on an annual or biannual basis. These courses are accessible to developing country scientists within the realm of "running an ISO17025 accredited veterinary diagnostic laboratory". It is recommended that further regional courses are held to address specific aspects in more detail to assist national/regional animal health control strategies and programmes – with special reference to avian influenza and other zoonotic diseases. There is growing interest and demand for isotopic and nuclear molecular techniques related to genetic and nucleotide sequence analyses, the tracing of the movement of animals (through the use of stable isotopes), the development of appropriate prophylactics (i.e. irradiated vaccines for trypanosomes, Rift Valley fever and other problematic disease agents), and an increased demand for higher levels of detection sensitivity (e.g. to identify and characterize carrier status animals.


## 3rd Consultants Meeting on Early Warning Devices and Tools to Diagnose Known and Unknown Emerging Diseases

Technical Officer: Gerrit Viljoen
The meeting was held from 13 to 16 October 2008 at the VIC, Vienna, Austria.
The purpose of the meeting was to evaluate progress and recommend future direction in the development of tools used for detection of transboundary animal diseases, including zoonotic agents. The specific objective was the discussion of amplification and non-amplification systems, biosensors, nanotechnology and equipment, environmental sampling technologies, remote sensing, communication technologies, administrative and logistical set-ups, networks and partnerships. The goal is to improve the early warning system, global capacity and diagnostic harmonization to enhance livestock production and health and to ensure the security of animal agriculture.
The rapid spread between countries and into new species of economically devastating animal and zoonotic diseases, such as recent examples of Bluetongue serotype 8 and Avian Influenza virus, highlight the need for early detection of high-threat transboundary animal diseases. Discussion during previous Joint FAO/IAEA consultants meetings targeted development of early warning devices and tools with the critical goal of preventing, rather than responding to outbreaks and emerging disease threats. Collaboration between private industry, researchers, and governmental agencies was identified as a critical means for rapidly advancing the 'fit-for-purpose' technologies needed for rapid, reliable disease detection and diagnosis at the farm level as well as in the laboratory. Those efforts have identified and continue to advance appropriate technologies to be used independently, and in concert, in order to provide seamless integration from sample collection through final analysis and reporting. On-site testing devices are now being validated including; single-use, disposable screening assays with integrated quality control, and a fully contained robotic device capable of sample processing, nucleic acid detection, and reporting of specific

transboundary diseases, such as foot-and-mouth disease and Avian Influenza. Though improvements to affordability and the range of agents detectable are critically required, prototype detection devices are in the process of field-validation prior to deployment. These devices could be used by regional and local veterinary laboratories, and ultimately farmers that would employ them for early warning leading to more rapid and effective response by veterinary authorities. Recently, remote sensing technology predicted ideal conditions for an outbreak of Rift Valley fever in Kenya, the United Republic of Tanzania and Sudan, facilitating earlier detection of the outbreak. For early warning tools to be effective, it is understood that the entire early warning system must be fully integrated and functional, necessitating a strong infrastructure. Efforts needed to provide a responsive early warning system include continued expansion of educational efforts, enhancements to risk analysis tools and reporting, and ongoing innovation in affordable and reliable real-time detection and diagnostic technologies that variously target agents and toxins, their genetic markers, and host response to infection.

Technologic advances critical for the rapid detection and diagnosis of high-threat diseases are becoming increasingly available in research and industrial laboratories. However these technologies have not yet been developed into the tools and devices needed for early warning against the many important livestock diseases affecting animal agriculture and food security of industrial and developing countries. Ease-of-use detection tests that function at the primary site of care were identified during initial sessions of the joint FAO/IAEA Early Warning Tools and Devices session as practical and field-deployable tools that could play an important role in early warning against transboundary disease agents. Pen-side tests using dip stick and lateral flow technologies have now been developed for rapid detection of selected transboundary diseases, and are in the process of field-validation. Developments that would allow the same technology to also serve as a stabilizing matrix for subsequent agent recovery and laboratory confirmation testing are underway. Similarly, since the first session of the Joint FAO/IAEA Division meeting, amplification systems such as real-time PCR and isothermal amplification techniques have become increasingly available for routine diagnostic application, and are increasingly accessible to member states. However, the efficient, affordable, and reliable devices that combine these amplification technologies with sample processing through analysis and reporting processes as envisioned during the early meetings have not yet been fully realized. A rugged, field deployable device that fully integrates sample processing, molecular detection, and remote-reporting has recently been developed as a prototype self-contained, portable laboratory. Initial validation of these on-site laboratories for sensitive and reliable detection of foot-and-mouth disease virus in the field has been initiated. Further integration of 'on-site' testing, with alternate sampling approaches, such as environmental-air sampling technologies, which have already proven the ability to capture and concentrate pathogens from animal environments, would additionally expand surveillance and early detection capabilities. Technical advances in freeze-drying, chemical inactivation, and stabilization of biologically active materials have also been made. The technologies are being applied to enhance accessibility and stability of detection reagents and devices, and show promise for improvements in collection, handling and transport of specimens, in turn improving the diagnostic quality of downstream reference testing. Molecular techniques, microfluidics, and expanded bio-informatics capabilities that allow rapid nucleic acid sequencing, in-depth phylogenetic investigation, and genomic characterization of pathogens have also advanced to the stage of being readily accessible to reference laboratories, but have yet to be functionally integrated with other early warning tools.

Remote sensing, thermography, syndromic surveillance, and disease prediction modeling were identified during initial meetings as tools applicable to early warning systems, but will require additional enhancement and evaluation before routine incorporation into early warning systems. Similarly the envisioned early warning system infrastructure continues to be developed, with current efforts focused on effective training programmes, including efforts such as OIE Twinning Projects that facilitate exchange of knowledge, ideas, and experience between laboratories in developed, developing, and in-transition countries. Infrastructure development will enhance laboratory capacity and expertise globally to insure effective detection and early warning regardless of where a transboundary or new disease may emerge.

Additional infrastructure needs include bench and on-site validation of not only devises and technologies but also for advanced approaches and strategies for surveillance, as well as ongoing incorporation of new and improved technologies into the early warning 'toolbox'.

**Future advancements**

Several promising technologies currently are either early in development, or are well-developed but not yet advanced to cost-effective, easily-transferable detection and diagnostic applications. Biosensors, nucleic acid and protein arrays, agent capture and concentration technologies, rapid pathogen quantitation, detection using microbeads, microfibers, nanoparticles, nanotubes, and nanowires show promise for the development of alternate formats and approaches to genome, protein, and disease marker detection. Additional efforts are needed to place the suite of tools in ease-of-use packages for field use, including improvements to collection and handling of relevant specimens, provision of timely and reliable reporting of results, and capture of appropriate risks in order to effectively target sampling for early warning.

The joint FAO/IAEA Warning Tools and Devices effort over the past 4 years has focused on understand-

ing the global animal health community's needs for an early warning system, and during that time has identified significant and dynamic advances in the technologies and devices appropriate for rapid detection and diagnosis of known high-threat and unknown emerging diseases.

The Joint FAO/IAEA Division has facilitated the establishment of international partnerships necessary to develop, evaluate, and validate the tools for early warning of animal disease threats.

Advances in miniaturization, fluid movement, and reagent stabilization now allow the integration of specimen processing, simultaneous detection of multiple pathogens, real time reporting, and specimen archiving processes in portable, rugged equipment suitable for on-site field use.

Advances in micro- and nanotechnology, bioinformatics, and molecular technologies have made rapid genomic sequence analysis and in-depth agent characterization possible at the level of the laboratory bench.

Continued directed efforts will be needed to ensure rapid evaluation and incorporation of technologic and computational advances that could enhance early warning through risk analysis and prediction, remote sensing, syndromic surveillance, environmental sampling, direct agent detection, detection and characterization using genomic and proteomic techniques, real time reporting, and enhanced communications.

The success of early warning technologies will be dependent on their use as part of an integrated and coordinated system that is able to effectively deploy the tools and harvest the information obtained in a rapid, reliable and responsive manner.

Routine use of appropriate early warning tools and strategies should be promoted through international cooperation in continuous development, field-validation, and deployment efforts.

International guidelines and coordinated efforts will be needed to assure the sustainable use of early warning systems through continuous training, education, and communication.

Accessible training, reference standards, proficiency evaluations, and ongoing field validation are needed to insure global harmonization and trust in the tools used for early detection and diagnosis of high-threat diseases.

Veterinary diagnostic laboratories globally should be equipped, enabled, and prepared to rapidly respond to the detection of disease agents and toxins, including the ability to provide rapid forensic investigation of high-threat and emerging agents.

The Joint FAO/IAEA Division should continue to aid in coordination of global efforts to develop, deploy, and support the use of early warning technologies for detection of animal and human pathogens or toxic agents that threaten the safety of the world's animals, food supply, and public health.

## Consultants Meeting on Training and Capacity Building for Research Workers in Animal Production and Health in Developing Countries

Technical Officer: John Crowther

The meeting was held from 13 to 15 October 2008 at the VIC, Vienna, Austria.

The consultants outlined their approaches and gave an overview of the success of programmes. Their programmes all led to qualifications through distance learning. The platforms were all open source. It was emphasised that contact with the teachers employed along with the packages was important for a short time during the courses. The target audience was also discussed and is an important feature in designing the most appropriate packages. In this context the training in research being made by the IAEA was highlighted and it was agreed that any level scientist could benefit as well as those registering for a Ph.D, including current supervisors, since it was agreed that research is made very poorly, with bad planning, in inappropriate areas and that this situation is maintained through poorly trained and quality controlled supervisors. Acceleration in the collection and design of the teaching package was recommended.

Training at all levels is vital for the development of quality scientists. The use of Web based learning platforms is highly successful. The flexibility of content management is necessary as well as the release of material to institutions to be used as they see fit for training.

The site which holds the education package under development can be visited under URL: researcher-training.org

## Regional Training Course on the Molecular Diagnosis, Epidemiology and Control of Animal Fascioliasis in the Latin American Region (RLA5049)

Technical Officers: Gerrit Viljoen/Kathrin Schaten

The regional training was held from 10 to 14 November 2008 in Havana, Cuba.

The objective of the training course was to harmonize and implement the best approaches and tools for molecular epidemiology, diagnosis, control and prevention of Fascioliasis, including theoretical and practical training and to determine the epidemiological spread of the disease, by classical and new generation techniques, and to identify areas at risk.

## The Final Project Coordination Meeting of the Technical Cooperation Project Support to African Union's Regional Programme for Control and Eradication of Major Epizootics RAF5055

Technical Officers: G. Viljoen & M. Lelenta

The final project coordination meeting took place at the Vienna International Centre, Vienna, Austria from 10 to 14 November 2008.
Project participants from Benin, Botswana, Burkina Faso, Cameroon, Democratic Republic of Congo; Ethiopia, Ghana, Kenya, Mozambique, Namibia, Nigeria; Sudan, Uganda, Zambia, and Zimbabwe, a representative of PANVAC and IAEA staff attended the meeting.
Participants voiced strong support for a new AFRA project (built on the now completed RAF5055 TC project) focusing more on molecular techniques to allow early and rapid diagnosis of transboundary animal diseases and those of zoonotic nature based on the sustainable transfer of diseases control technologies including training and harmonization of test protocols and procedures, technical laboratory support and laboratory infrastructure guidance and the development of a Laboratory Information Management System to improve veterinary diagnostic laboratory quality management. The final report of project RAF5055 will be made available as soon as possible.

### Early and rapid diagnosis of emerging diseases (focus on Avian Influenza) 2006-2012 D3.20.25

Technical Officer: John Crowther
The second RCM was held at the Institute of Animal Science and Veterinary Medicine, Chinese Academy of Agricultural Sciences, Beijing, China, from 24 to 28 November 2008.
The RCM reviewed the work made in the counterpart laboratories since the last RCM and make work plans utilizing modern developments in rapid diagnosis involving variations of rt-PCR, as well as instant reporting possibilities, to allow systems of instant testing and reporting.
The CRP is seen as an excellent body for validating such systems to allow field side testing and reporting advantages to allow better control of livestock diseases.
It is envisaged that at the time of the meeting a commercial detection technology will be validated sufficiently in the laboratory to allow its dissemination into the laboratories of the research contract holders to allow field validation.

# Coordinated Research Projects

### Integrated Approach for Improving Small-scale Market Oriented Dairy Systems (D3.10.23)

Technical Officer: Mario Garcia Podesta
The activities of this CRP have been completed. The final RCM was held in Edinburgh, UK, from 4 to 8 December 2006. The papers containing results from Participatory Rural Appraisals and Economic Opportunity Surveys performed in the initial phase of the CRP were published as a Special Issue of the scientific journal Tropical Animal Production and Health. Hard copies of this issue are available on request. The final reports containing results from the second phase of the CRP are now being prepared for publishing as an IAEA-TECDOC.

### Development and Use of Rumen Molecular Techniques for Predicting and Enhancing Productivity (D3.10.24)

Technical Officer: E. Nicholas Odongo
The project is progressing well and on track to achieving its objectives. CRP contract holders have identified several plant species and products that can reduce methane production in vitro. For example, a recent article from the CRP (Agarwal, N., et al., Effect of peppermint (*Mentha piperita*) oil on in vitro methanogenesis and fermentation of feed with buffalo rumen liquor, Anim. Feed Sci. Technol. (2008), doi:10.1016/j.anifeedsci.2008.04.004) suggests antimethanogenic and antiprotozoal activities of peppermint oil but its mode of action and optimal level of inclusion (dose per unit feed) warrants further investigations in vivo.
Results from different sites suggest that secondary metabolites present in plants have anti-protozoal effects and could modulate ruminal fermentation patterns and therefore have the potential to reduce methane production in ruminants while improving the efficiency of nutrient utilization. Such identified plant materials are now being evaluated for methane suppression effects and productivity factors in animal studies.

### Gene-based Technologies in Livestock Breeding: Phase 1: Characterization of Small Ruminant Genetic Resources in Asia (D3.10.25)

Technical Officer: Mario Garcia Podesta
The genotyping for all 18 microsatellites of the sheep has been completed, at the Joint ILRI/CAAS animal molecular genetics laboratory in Beijing. The counterpart from Bangladesh (Mr Omar Faruque) is organizing the data from each of the countries into the same format and then will distribute the joint datasets to each counterpart on a CD. The genotyping of 37 breeds of goats for 15 microsattelite markers has been completed. The

IAEA Collaborating Centre on Animal Genomics and Bioinformatics, located in Brazil, is currently a contract holder of this CRP by performing the sequencing of mitochondrial DNA of a subset of individuals from Asian sheep and goat breeds, aiming to reveal differences among them in the D-loop region of the mtDNA. The São Paulo State University (UNESP) group, lead by Mr Fernando Garcia, has developed kits for DNA amplification, which were distributed to the nine counterparts. DNA sequencing work is on the way in his lab and final results are expected by the fourth quarter 2008, when data will be compared and analysed in order to provide new information about genetic diversity among sheep and goat breeds, facilitating decision making initiatives on those livestock breeds conservation. Phenotypic and farming system information has been collected for each breed, and will be inserted into the Domestic Animal Diversity Information System (DAD-IS) of the FAO. Protocols for genotyping of SNP in various candidate genes that may influence traits of economic importance in small ruminants are in progress at IAEA Animal Production Unit in Seibersdorf. The genotyping and data analysis needed for basic genetic characterization is expected to continue through the end of 2008.

## Veterinary Surveillance of Rift Valley Fever (D3.20.23)

Technical Officer: Gerrit Viljoen

The main objectives are the evaluation, validation and implementation of rt-PCR and PCR sequencing procedures for early and sensitive detection of the RVF virus and its use in molecular epidemiology using isotopic techniques to improve diagnostic sensitivity (via isotope incorporation into PCR amplicons) and to confirm diagnostic specificity (via hybridization of amplicons with isotope labeled probes). In laboratories equipped with real-time PCR capabilities, the manual PCR procedures are being adapted to include their use as part of the Standard Operating Procedures (SOPs). Manual isotope based slab PCR-sequencing procedures are implemented (In laboratories equipped with automated sequencing equipment, these procedures will be adapted for use). The specific objectives are:

- Evaluation, validation and use of iELISA formats to detect virus-specific antibodies.
- Evaluation of recombinant antigens for use in indirect and competition ELISA's.
- Harmonization of Standard Operating Procedures (SOPs) and introduction of quality assurance procedures for RVF-ELISA.
- Evaluation, validation and implementation of classical rt-PCR and real-time PCR, and PCR sequencing procedures for early and sensitive detection of the RVF virus and its use in molecular epidemiology
- Setting up of a serological and molecular epidemiological database (based on antibody prevalence and virus isolate genetic variation).

This CRP is under the IAEA Project 'Molecular Technologies for Improving Productivity in Smallholder Livestock'. The aim of the CRP is to develop, evaluate, validate and harmonize nuclear and nuclear related serological and molecular diagnostic technologies to improve Member State capacities to effectively control transboundary animal diseases. Rift Valley fever (RVF) is one of the several important diseases of livestock that are targeted under this project. RVF epidemics occur at irregular intervals in Africa when heavy rains facilitate the breeding of the mosquito vectors. The latest outbreaks were in Kenya (2006/7), the United Republic of Tanzania (2006/7), Sudan (2007/8) and South Africa (2008), leading in some cases to great losses in animals and humans.

Progress towards achieving the objectives of the CRP is satisfactory and all the RCH are within the timeframe of their work plans. In short: The IgG and IgM ELISA platforms (using irradiated virus antigens and control sera) were evaluated, validated and implemented in RCHs laboratories (and other laboratories); The serological procedures were harmonized and are available as SOPs; the RCHs were trained in molecular technologies and quality assurance management; the recombinant RVF antigen was evaluated and is under validation as substitute antigen for the ELISA platforms and epidemiological and surveillance (including sampling frame) strategies were developed and are implemented by all RCHs. The future objectives to be achieved (2009) are: evaluation, validation and implementation of the molecular diagnostic platforms and procedures and their presentation to OIE, FAO and WHO; the validation of the recombinant ELISA platform; the finalization of the DNA and sera reference material; continued maintenance of the established epidemiological databank.

Rift Valley fever (RVF) inflicts great economic losses due to reduced productivity in livestock, widespread abortions in pregnant animals and mortality in young animals. In addition, RVF is zoonotic and may cause debilitating encephalitis, blindness and deaths in humans. The virus was first isolated in 1930 in sheep in the Rift Valley of Kenya and is endemic to sub-Saharan Africa with sporadic outbreaks in the Arabian Peninsula. RFV outbreaks have severe consequences to trade in the region.

RVF epidemics occur at irregular intervals in Africa when heavy rains facilitate the breeding of the mosquito vectors. The latest major outbreaks were in Kenya (2006/7), United Republic of Tanzania (2006/7), (2007/8) and South Africa (2008), leading in some cases to great losses in animals and humans. With rising or fluctuating global temperatures, RVFV can spread to new ecosystems. In September 2000, RVF was first reported outside Africa in Saudi Arabia and Yemen, disrupting all livestock trade from the horn of Africa to the Arabian Peninsula. In Yemen, the 2000 RVF outbreak affected more than 2000 humans, killing nearly 300 people, while 20 000

abortions occurred in livestock. This expansion in the epidemic area to the Arabian Peninsula raises the possibility of RVF spread to other parts of Asia and Europe, especially since RVFV can be spread by a wide range of mosquito vectors. Although transmission is mainly by mosquitoes, it can also occur via contact with infected animals (in the case of veterinarians or abattoir workers), infected blood or tissue samples (laboratory workers) and patients (family, physicians or nursing aides).

Inactivated and attenuated RVF-vaccines are available for veterinary use although both have limitations (they cause abortions), but none are available commercially for humans. It is therefore critical to confine and control the spread of the virus and to limit its spread to non-infected animals and to humans, and prevent spread to non-endemic areas. This can be achieved by the rapid, early and definitive detection of RVFV and consequently controlling animal movement, instituting quarantine measures and/or implementing suitable vaccination strategies. Hence, considerable efforts have been made recently to validate and implement techniques for the rapid and early diagnosis and characterization of RVFV. Enzyme linked immunosorbent assays (ELISA) have the potential to detect RVF specific antibodies in RVFV –infected animals, although their use has been limited due to the lack of standardized procedures, validation data and the unavailability of safe antigens. It is, however, not able to differentiate between vaccinated and field-infected animals; therefore the laborious monitoring of sentinel animals in herds in endemic areas is still required.

In addition, it is of paramount importance to identify the presence of virus as early as possible, even within the window period prior to the development of RVFV antibodies, to allow for the timely implementation of action. Thus the nuclear and nuclear related molecular detection of RVFV was developed and evaluated with a limited panel of field samples. This approach is not only highly specific but can detect presence of RVFV nucleic acid in infected animals during the window period prior to sero-conversion. Only a few of the participating countries were able to implement this technique during this stage and it is expected that all counterparts will participate in the validation phase.

The validation of the serological IgM and IgG platforms (using irradiated or recombinant antigens and irradiated control sera) together with the early stage molecular diagnostic techniques greatly contributed, in the countries experiencing RVF outbreaks (e.g. Kenya and Sudan), to the early and rapid diagnosis of RVF and allowed for the timely response and effective control. The molecular diagnostic technologies and the molecular characterization (i.e. sequencing) of all RVFV isolates will form the last part of this CRP (as basis of the DNA database), using either isotope or fluorescent labeling of sequences, to obtain a genetic databank for the rapid bioinformatical analysis and classification of all isolates. This will allow for molecular epidemiological studies to determine the origin and spread of the virus, the origin of outbreaks as well as in helping to differentiate vaccine virus from wild-type field strains.

There is no human vaccine available, and the animal vaccine that is being used cause abortions in pregnant animals. Two of the RCHs are currently evaluating the efficiency of irradiated RVF as save and potent immunogens (i.e. providing a more complete MHC class I and II protection) for animals and possible humans (outside of the CRP scope).

The final RCM will be held at the Vienna International Centre, from 8 to 13 June 2009.

## The Control of Contagious Bovine Pleuro Pneumonia in Sub-Saharan Africa (D3.20.24)

Technical Officer: Hermann Unger

Since the second RCM in Mali, the work in Vienna focused on the application of the Loop-mediated Amplification PCR for CBPP. A number of primer sets were tested, but up to now we could not get consistent positive results. This is partly due to the high GC content, making primer design a real struggle. On the other hand, there are quite some point mutations in the M.m.m.SC genome, which did not allow the amplification of some of our strains. Progress was made on other issues of LAMP, which you find in the Seibersdorf section of this newsletter.

The re-development of the LPPQ ELISA was not successful in the sense that serum samples had to be diluted 1/400 to give a good back ground ratio. As other research institutions had the same problem, and the comparison trial in Zambia revealed a few shortcomings, we decided to discontinue the trials on this antigen. Instead, a technical contract was prepared to examine 20 more CBPP specific antigens for their potential use in an ELISA format. This work should come up with preliminary results mid of next year.

The future focus of the CRP should be on the application of PCR for CBPP and we are currently preparing the technical details and protocols to start early next year.

## The Early and Rapid Diagnosis of Transboundary Animal Diseases such as Avian Influenza (D3.20.25)

Technical Officer: John Crowther

The second Research Coordination Meeting was held fom 24 to 28 November 2008 at the Institute of Animal Science and Veterinary Medicine, Chinese Academy of Agricultural Sciences, Beijing, China. More details on the RCM please read under ‘Past Events’.

## The Early and Sensitive Diagnosis and Control of Peste des Petits Ruminants (PPR) (D3.20.26)

Technical Officer: Hermann Unger

The first Research Coordination meeting took place from 31 March to 4 April 2008 in Vienna, Austria.

Reports from the research contract holders show that PCR is now in use in a number of labs with good results, the c-ELISA is working in most laboratories and more detailed information on the prevalence of PPR is becoming available.

While field work on the validation of the PPR c-ELISA is continuing, the progress in molecular diagnostics is slow. For the LAMP PCR, up to now, no primer set tested did identify all 4 strains. Please see more on this in the Seibersdorf section.

## General information applicable to all Coordinated Research Projects

**Submission of Proposals**

Research Contract proposal forms can be obtained from the IAEA, the National Atomic Energy Commissions, UNDP offices or by contacting the Technical Officer. The form can also be downloaded from the URL http://www-crp.iaea.org/html/forms.html

Such proposals need to be countersigned by the Head of the Institutions and sent directly to the IAEA. They do not need to be routed through other official channels unless local regulations require otherwise.

**Complementary FAO/IAEA Support**

IAEA has a programme of support through national Technical Cooperation (TC) Projects. Such support is available to IAEA Member States and can include additional support such as equipment, specialized training through IAEA training fellowships and the provision of technical assistance through visits by IAEA experts for periods of up to one month. Full details of the TC Programme and information on how to prepare a project proposal are available at the URL http://www-tc.iaea.org/tcweb/default.asp

For further information contact Roswitha Schellander (r.schellander@iaea.org)

# Activities of the Animal Production Unit (APU) at the FAO/IAEA Agriculture and Biotechnology Laboratory

## Adapting Gene Technologies to Field Situations

Enhancing food security by providing effective control of infectious diseases in livestock requires major investment in developing diagnostic technologies of sufficient sensitivity and precision to enable veterinary authorities to accurately identify animal carriers of disease and to carry out appropriate measures for containing an outbreak. Diagnosis typically requires the identification of the infective organism, and this may be possible at point-of-care in certain instances where the disease agent can be identified microscopically from the various body fluids. However, in many cases, this method is not applicable and diagnosis requires laboratory backup to provide the information. Gene amplification methods provide a way of doing this without resorting to culture of viral or bacterial pathogens or collecting large amounts of biological samples. These methods, based on the Polymerase Chain Reaction are highly sensitive and specific, but incur a delay in transferring materials, analysing and providing the results. In some instances, this delay can be counterproductive in establishing an efficient disease control programme. For instance, in the foot-and-mouth disease outbreak in the UK in 2001, delays in obtaining diagnosis meant that nearly 25% of farms declared infected on clinical grounds were actually free from disease. Being able to improve this decision-making gap would be an advantage, especially in the case of transboundary diseases, including Highly Pathogenic Avian Influenza, (HPAI) where suspected disease may occur in remote areas, far from the laboratory and where speedy diagnosis of a dangerous potential zoonoses is of paramount importance. Loop mediated isothermal amplification (LAMP) provides a means for applying molecular technologies to the penside as it does not require thermal cycling and the results can be visualized with the naked eye. Recently, Mr Oliver Scheiber, a consultant at APU, investigated the potential of applying LAMP technologies to the diagnosis of Avian Influenza (AI), Peste des Petit Ruminants (PPR) and Contagious Bovine Pleuro-Pneumonia (CBPP). The work involved looking at technical modifications of the LAMP process to improve performance; these involved testing alternative polymerases, using PCR enhancers, optimizing reaction temperatures and testing lyophilized master mixes.

The Avian Influenza RT-LAMP was based on a published method to which various modifications were applied in order to evaluate potential improvements in its functionality.

Originally the test results were read using a turbidimeter, but such equipment it is not routinely used in most laboratories. Hence, the first step was to change the method to a fluorometric one, by adding EVA-Green dye to the reaction mixture as an indicator. The amount of pyrophosphate precipitate that develops during the reaction was minimized by lowering the magnesium concentration, thereby solving the problems encountered in reading the fluorescence signal. Interestingly, lower magnesium concentrations had the added effect of making signal development faster.

The dNTP and the primer concentration were then also optimized, leading to lower reagent usage and faster amplifications.

An alternative strand-displacing polymerase (Bsm), supplied by Fermentas was evaluated for use in the LAMP and found to be roughly comparable with Bst. As there was no optimized buffer system for Bsm available, the buffer system for Bst, the usual polymerase, was used instead. This resulted in slightly quicker results (less time to signal development) for Bst.

Betaine is an agent that has been used successfully for increasing yield and specificity of PCR products by reducing the formation of secondary structure caused by GC-rich regions, but it is rather expensive. Trehalose can also enhance the activity of certain enzymes, so its use in LAMP was evaluated. Betaine actually inhibited AI-RT-LAMP when using Bst, whereas Bsm needed a certain concentration of betaine to work. Trehalose could replace betaine in LAMP for both Bst and Bsm.

The use of trehalose opened up another possibility; trehalose can preserve enzymatic activity when drying enzyme solutions. The dried master mix was found stable at room temperature, making it possible to prepare in advance large quantities for a whole series of experiments and for use over a long period, with possible benefits for standardization and quality assurance. It could even be possible for a central laboratory (e.g. Seibersdorf) to prepare master mix for supplying partner institutes, making it easier to compare inter laboratory results.

This drying should at the same time reduce the risk of contamination as mentioned in a number of publications. Isothermal conditions used for LAMP are usually between 60–65°C, with an optimum of 62.5°C.

However, in our tests performed between 55–65°C it was found that optimum temperatures for both Bsm and Bst were below 60°C and gave faster then published positive results for AI-RT-LAMP (optimum around 57°C).
The formation of crystals by Mg-pyrophosphate makes it possible to read a positive result of LAMP using the naked eye, but at the same time inhibits the polymerase. Pyrophosphatase (PP) converts Mg-pyrophosphate to ortho-phosphate liberating the Mg and reducing the inhibition of the reaction and the reading of the fluorescence. So the inclusion of PP could make the PCR (and LAMP) more efficient. It was found that this enzyme does have an effect on LAMP, but only in the late phase of the reaction - the signal did not come earlier, but a stronger signal developed over time (Figure 1).

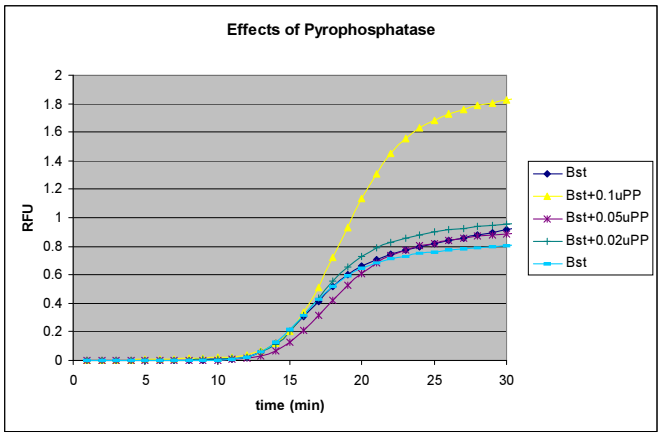


*Figure 1: Effects of Pyrophosphatase concentration on the fluorescence development of AI LAMP.*

Thus, the addition of PP could be of value if the signal to noise ratio needs to be influenced to give more stable results in a difficult LAMP test.
An experimental PPR-LAMP was performed on plasmids with inserted sequences available in Seibersdorf. It was found that reaction varied greatly with different strains, from no detection to fast amplification. This was ultimately traced to the location of the primers on relatively variable sequence elements. Using this information, new primer sets, in less variable regions, were designed by Mr Hermann Unger and will be tested in near future.
For the CBPP-LAMP, a set of primers was tested on CBPP DNA. While the outer primers were able to amplify DNA in a conventional PCR for 8 out of 9 strains examined, a LAMP using both outer and inner primers failed to give a signal. Here as well, new primer sets are under evaluation.
The results obtained with the AI LAMP give promise that the LAMP can be further developed into a rapid and quality assured diagnostic system. The EVA green based platform will help to better evaluate these tests with established laboratory equipment in our counterpart laboratories for the fitness for purpose and their future field application.

## Peste des Petits Ruminants (PPR) marker vaccine project

Peste des Petits Ruminants (PPR) is an infectious disease caused by a highly contagious virus, the PPR virus (PPRV), belonging to the genus *Morbillivirus*. This genus causes some of the most devastating viral diseases of humans and animals worldwide and as well as PPR it includes measles virus, canine distemper virus and rinderpest virus (RPV). These viruses show a high degree of antigenic relatedness amongst their structural proteins. One of these proteins, the nucleoprotein (N), is the most abundant and is the one against which most of the antibodies produced in infected animals are directed. The N gene of PPRV encodes a protein moiety consisting of 525 amino acids (aa). Sequence comparison studies of this nucleoprotein within the *Morbillivirus* genus have identified three main regions with different homologies:

- The N-terminal region of medium homology
- The highly conserved central region
- The poorly conserved C-terminal domain (N-tail) covering the last 105 amino acids (aa)

A number of monoclonal antibodies (MAbs) have been produced against N protein, but their epitopes recognize sites on the least conserved aa sequences of the amino and carboxy termini of the N protein. When one of these specific PPRV N MAbs, P4G5, was used in a competitive ELISA (cELISA) test it was found that there were cross reactions with sera taken from animals infected with RPV. It is therefore essential to develop a species-specific ELISA test that can discriminate between the different morbiliviruses. To this end, we are trying to analyse the antigenic and immunogenic properties of the PPRV N protein. To characterize the antigenic structure of the PPR virus nucleoprotein (N) and, in particular, to determine the most highly immunogenic regions, the entire protein and several deleted mutants were expressed in a baculovirus system. These proteins were used in indirect ELISA (iELISA) using PPR positive and negative sera obtained from goats. The preliminary results of this study indicated that most anti-N antibodies developed by PPR-infected goats are probably conformational.
To identify the relevant specific antigenic site for use in an iELISA for PPR serology, the aa sequences 421–490 and 421–525 from PPR N protein (Figure 2, see below) were cloned and expressed in the baculovirus system.
These were used as coating antigens on 96 microwell plates. The results showed that the polypetide ‘aa 421 to 490’ is not recognized by a high PPR positive serum from an PPR-infected goat (C++) (Figure 3).

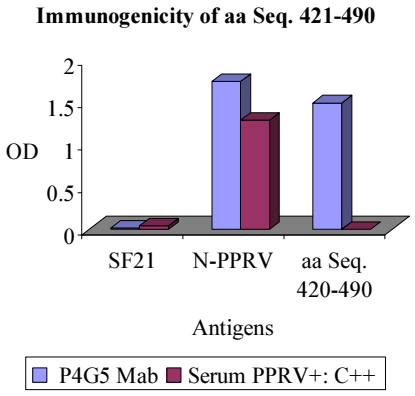


*Figure 3: Results of iELISA using the polypeptide from aa 421–490 of PPRV N protein as antigen. SF21 non-infected cells and PPRV N protein were used as control antigens in the test.*

Hence, it seems that the hypervariable region of the PPRV N protein is not highly immunogenic and does not posses epitopes that can be recognized by the immune system from animals naturally infected with PPR. However, iELISA tests based on the polypeptide sequence from PPRV N protein aa 421 to 525 (N▲1/420) showed that this antigen does have epitopes that are recognized by PPR positive serum (Figure 4).

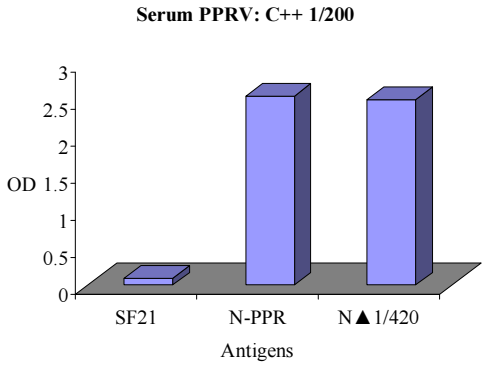


*Figure 4: Results of iELISA using the polypeptide from aa 421–525 (N▲1/420) of PPRV N protein as coating antigen.*

The epitopes in the N-tail recognized by the PPRV positive serum from goat must therefore be located between the aa sequence from positions 491 to 525. Optical density measurements using polypeptide N▲1/420 in iELISA were similar to those when the entire PPRV N protein was used, suggesting that the aa sequence 491–525 contains immunodominant epitopes.

To investigate the specificity of the polypeptide N▲1/420 as an antigen in iELISA for PPR diagnosis, positive sera from cattle infected with Rinderpest were used in the test to determine the extent of cross-reactivity. The result obtained show (Figure 5) that antibodies from a RPV positive serum fails to bind to the polypeptide N▲1/420 from PPRV.

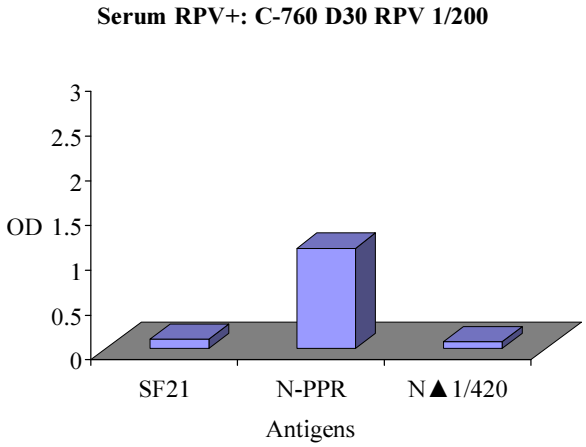


*Figure 5: Results from positive RPV serum in iELISA using the polypeptide N▲1/420 of PPRV N protein as coating antigen.*

Hence, the aa sequence 506–515 of PPRV N protein which presents a medium homology with the RPV N protein possesses the specificity for the PPR. Thus, polypeptide N▲1/420 from PPRV could therefore be a good candidate as antigen in a PPR-specific iELISA. Further tests, using a larger panel of positive PPR and RPV sera will enable us to confirm this hypothesis.

Previous studies of Nucleocapsid protein (Np) of PPRV interaction with itself gave us some information about the amino-acid sequences involved in the formation of the virus nucleocapsid.

In order to continue the characterization of the non functional domain of the Np, we analysed the amino-acid sequence of this protein involved in the interaction with PPRV phosphoprotein by immuno-precipitation and peptide ELISA tests. For the immuno-precipitation we co-expressed the P protein and the different N proteins (entire and mutants). The complex P and N proteins were immunoprecipitated with an anti-N monoclonal. The results of immunoprecipitation indicate that P interacts with all N deleted mutants in the same way as with the full N. This indicates that the P protein interacts with several domains on the N protein and the N and C-termini. To define more precisely the domain of N protein that interacts with P, we used 62 overlapping peptides of N in a protein-ELISA assay. The results obtained showed that two regions of N, one at the N-terminal and another at the C-terminal end, interact with P.

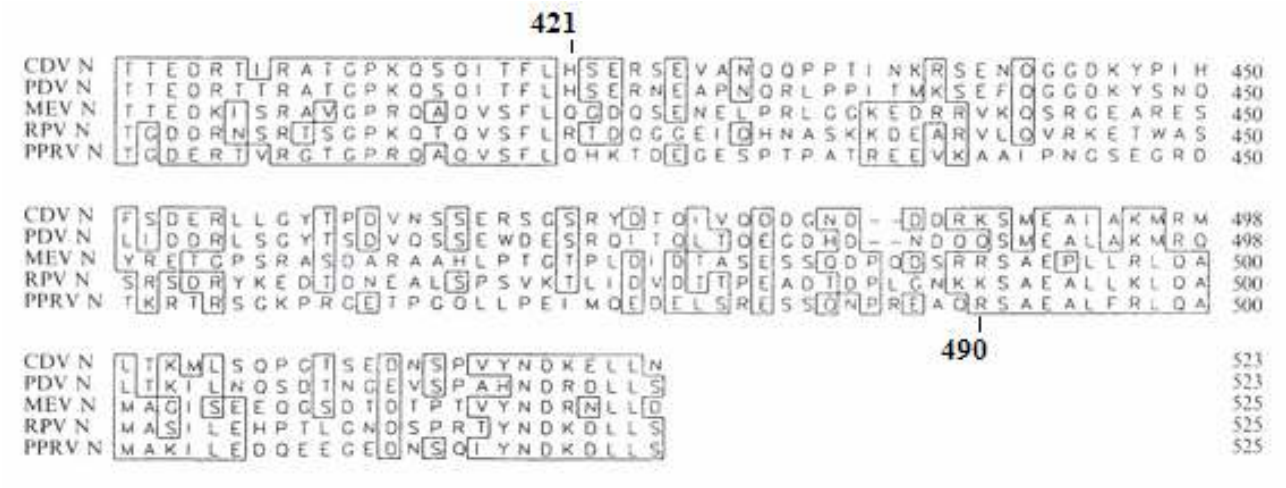


*Figure 2: Alignment of the poorly conserved C-terminal domain (N-tail) of the N protein of Morbillivirus*

# Technical Cooperation Projects

| TC Project | Description | TO |
|---|---|---|
| ANG/5/007 | Improvement and Veterinary Assistance to Local Small Stock Breeds<br>**Objective:** The sustainable improvement of small-scale livestock production systems. | Viljoen |
| BEN/5/003 | Veterinary Drug Residue Monitoring Programme<br>**Objective:** To develop a capacity for veterinary drug residue monitoring in livestock products. | Viljoen<br>Cannavan<br>Patel |
| BKF/5/006 | Establishment of Feeding Tables for Feedstuffs that are Locally Available to Stockholders in Burkina Faso<br>**Objective:** To improve the reproductive performance of local livestock bred through food supplementation strategies, develop feeding table for locally available food resources, characterize genetic types of cattle used for milk production, improve the effectiveness of artificial insemination on local cattle breeds, and train a qualified team on animal production (nutrition, feeding, reproduction and genetics). | Garcia Podesta<br>Odongo |
| CAF/5/002 | Assistance for Epidemiological Surveillance of Animal Diseases<br>**Objective**: To strengthen the diagnostic capacity of the Central Veterinarian Laboratory (LACAVET) to monitor and control major animal diseases. | Unger |
| CMR/5/015 | Use of Nuclear Techniques for Improving Ruminant Productivity & Disease Control<br>**Objective**: Develop capability for improved breeding by disease control and artificial insemination. | Garcia Podesta<br>Unger |
| ELS/5/010 | Improving Nutrition Practices and Reproductive Efficiency in Cattle<br>**Objective:** To increase milk production and profitability of dairy farms through development and use of appropriate feeding strategies using locally available feed resources and enhancing reproductive efficiency. | Odongo<br>Garcia Podesta |
| ERI/5/005 | Zoonotic (diseases that can be transmitted from animals to humans) Disease Control and Analysis of Veterinary Residues in Foods<br>**Objective**: The objective of the project is to determine: 1. The epidemiological prevalence of brucellosis and tuberculosis in the major dairy producing areas; 2. Baseline data on veterinary drug residues in milk and meat products. | Patel<br>Unger |
| ETH/5/012 | Integrating Sterile Insect Techniques for Tsetse Eradication<br>**Objective**: To eradicate the tsetse fly from the southern Rift Valley, thereby creating an environment conducive to livestock development and improved agricultural production. | Feldmann<br>Parker<br>Viljoen |
| ETH/5/014 | Monitoring and Control of Major Animal Diseases<br>**Objective**: To strengthen the diagnostic capacity of the National Veterinary Institute to monitor and control trans-boundary diseases, particularly foot and mouth disease and contagious bovine pleuropneumonia. | Viljoen |
| GAB/5/002 | Diagnosis and Control of Animal Diseases<br>**Objective**: To aid identification and control of livestock diseases. | Crowther<br>Unger |
| HON/5/002 | Improvement in the Nutritional and Sanitary Conditions of Cattle to Enhance their Productivity through Nuclear Methods<br>**Objective**: To enhance the national capabilities for developing feeding strategies, improving the reproductive status of cattle and diagnosis of diseases in livestock herds through isotopic techniques. | Odongo<br>Garcia Podesta<br>Viljoen |
| HON/5/004 | Improving the Nutrition and Health Conditions of Livestock in Honduras in Order to Increase Productivity and Reproductivity, Phase II<br>**Objective**: To strengthen and improve livestock production in Honduras. | Odongo<br>Garcia Podesta<br>Viljoen |

| TC Project | Description | TO |
|---|---|---|
| INS/5/034 | Development of Environmentally Sound Livestock and Agricultural Production<br>**Objective**: To improve livestock productivity without adversely affecting the environment through improved feed supplementation strategies, managing nutrient waste on farms and reducing methane emissions. | Odongo |
| IRA/5/012 | Preparation of ELISA Kits for Diagnosis of Foot and Mouth Disease<br>**Objective**: To establish the ability to prepare standardized assays for use in foot and mouth disease (FMD) control. | Crowther |
| MAU/5/002 | Improving the National Capacity in Diagnostics for Animal Diseases (Infection and Parasitic Diseases)<br>**Objective**: To strengthen the diagnostic capacity of the Centre National D'Elevage et de Recherches Veterinaires (CNERV) to monitor and control trans-boundary animal diseases, particularly foot and mouth disease and contagious bovine pleuropneumonia. | Luckins<br>Schaten |
| MLI/5/019 | Improving Pneumopathies Diagnosis in Ruminants Using PCR<br>**Objective**: To improve knowledge about the epidemiology of the dominant respiratory pathologies affecting small ruminants in Mali's agro-pastoral areas through improving the diagnosis of pneumopathies in small ruminants to support the national control and eradication programme. | Viljoen |
| MON/5/012 | Monitoring of Residues in Livestock Products and Surveillance of Animal Diseases<br>**Objective**: To develop a capacity for veterinary drug residue and contaminant monitoring in livestock products and to expand serosurveillance capabilities to achieve rinderpest and foot and mouth disease (FMD) free status in the country or specific zones. | Cannavan<br>Crowther |
| MON/5/013 | Diagnosis and Surveillance of Transboundary Animal Diseases and Production of Diagnostic Reagents<br>**Objective**: To obtain international recognition of freedom from several transboundary animal diseases, to develop a capacity for the local production, standardization and validation of diagnostic reagents and diagnostic kits, and to establish a quality system for diagnosis of transboundary animal diseases using the local produced diagnostic kits. | Crowther<br>Viljoen |
| MON/5/016 | Improving Productivity of Cattle, Camels and Yaks Through Better Nutrition and Reproductive Management<br>**Objective**: To increase milk, meat and wool production of yaks, cattle and camels by improving the quality and quantity of feed with high nutritional value and tolerance to low temperature and improving the genetic potential using artificial insemination coupled with radio immunoassay for progesterone. | Odongo<br>Garcia Podesta |
| MOR/5/030 | Improving Sheep and Goat Production in Morocco through Genomic and Reproductive Physiology Characterization with the Help of Radio-immunoassay and Molecular Techniques (Not yet funded)<br>**Objective**: Increase sheep and goats for consumption and producers' revenue while preserving natural resources. | Garcia Podesta<br>Malek |
| MYA/0/006 | Human Resource Development and Nuclear Technology Support<br>**Objective**: To upgrade and strengthen the skills and capabilities of human resources within the broad range of the applications of nuclear science and technology. | Dias<br>Khan<br>Crowther |
| MYA/5/013 | Integrated Approach for Enhancing Cattle Productivity<br>**Objective**: To improve smallholder dairy cattle production in Yangon and Mandalay regions. | Garcia Podesta<br>Odongo |
| MYA/5/015 | Strengthening the National Capacity for the Production of Veterinary Vaccines<br>**Objective**: To enhance the national capacity for quality vaccine production to support efforts to control infectious diseases in livestock production, particularly FMD. | Crowther<br>Cannavan |

| TC Project | Description | TO |
|---|---|---|
| NER/5/011 | Upgrading Laboratory Services for Diagnosis of Animal Diseases<br>**Objective**: To support the Government effort in controlling main livestock trans-boundary diseases, mainly contagious bovine pleuropneumonia (CBPP), peste des petits ruminants (PPR) and foot and mouth disease (FMD). To help improve the national animal disease diagnosis capabilities at the Laboratoire Central d'Elevage (LABOCEL) in the use of modern techniques to obtain specific and rapid results with focus to CBPP, PPR and FMD. | Luckins<br>Unger |
| NER/5/013 | An Integrated Approach for Improvement of Livestock Productivity<br>**Objective**: To increase the productivity of livestock through implementation of an integrated programme dealing with nutrition and reproduction. | Odongo<br>Garcia Podesta<br>Luckins |
| PER/5/027 | Use of Nuclear Techniques to Improve Alpacas Productive and Reproductive Methods<br>**Objective**: To improve reproduction performance of alpacas using nuclear and related techniques to recover and conserve the individual species. | Garcia Podesta |
| PER/5/029 | Genomics of the Alpaca: Identification of Expressed Genes and Genetic Markers Associated with Productivity and Embryonic Mortality<br>**Objective**: To identify and characterize the factors associated with embryonic mortality in alpacas. | Garcia Podesta<br>Malek |
| RAF/5/054 | Improvement of Livestock Productivity through an Integrated Application of Technologies (AFRA III-4)<br>**Objective:** To develop and facilitate the application of appropriate selection criteria for genetically improved stock; to institute integrated management, nutrition, healthcare and follow-up practices for genetically improved stock; and to use modern reproductive techniques to improve productivity and reproductive efficiency of livestock in the region. | Garcia Podesta<br>Odongo |
| RAF/5/055 | Support to African Union's Regional Programmes for Control and Eradication of Major Epizootics<br>**Objective**: To support within the framework of a strategic partnership with the African Union, the global effort of control and eradication of major trans-boundary animal diseases affecting livestock in the region led by the Inter-African Bureau for Animal Resources (AU/IBAR). This programme will aim at helping African countries to improve and produce livestock to ensure their role and participation in international markets that will lead to poverty alleviation and increased livelihoods. The specific objectives of the project are (i) to provide support to selected national veterinary laboratories to implement a quality assured disease control programme; (ii) to transfer appropriate and state-of-the-art technology to support diagnostic, surveillance and epidemiological activities relating to the control of major livestock diseases; and (iii) to support the establishment of a regional centre in Africa (Pan African Veterinary Vaccine Centre [PANVAC]) that would be responsible for (a) the production, assembly and distribution of diagnostic kits; (b) evaluating and monitoring the development of quality assured animal vaccines and (c) advising on the use of vaccines and vaccine strategies. | Viljoen<br>Lelenta |
| RAS/5/044 | Integrated Approach for Improving Livestock Production Utilizing Indigenous Resources and Conserving the Environment (RCA)<br>**Objective**: To improve livestock productivity through better nutritional and reproduction strategies while conserving the environment. The specific objectives are to improve animal productivity and decrease discharges of selected greenhouse gases, (methane and carbon dioxide) and selected nutrients (nitrogen and phosphorus) into the environment; and to identify and adopt better breeding strategies that will improve animal productivity through the use of better selection criteria for offspring from cross-breeding programmes, optimum utilization of appropriate indigenous cows, benchmarking for growth and reproduction, and improving procedures for management, nutrition and healthcare programmes in dairy farms. | Garcia Podesta<br>Odongo |
| RLA/5/049 | Integrated Control of Fascioliasis in Latin America (in support of National Programmes | Viljoen<br>Schaten |

| TC Project | Description | TO |
|---|---|---|
| SIL/5/006 | Improving the Productivity of N'dama Cattle<br>**Objective**: To establish a national capability for the application of nuclear techniques to (i) assess the nutritional quality of locally available feed resources, and to develop optimal feeding strategies, (ii) evaluate the reproductive performance under different management and nutritional conditions, and improve artificial insemination (AI) services, and (iii) diagnose and determine epidemiological status of important diseases. | Garcia Podesta |
| SIL/5/010 | Improving the Productivity of Ndama Cattle In Sierra Leone<br>**Objective**: To strengthen the diagnostic capacity to monitor and control animal diseases affecting cattle, (ii) to apply feeding strategies and supplementation packages, and (iii) to produce hydrids with greater potential for increased growth rate and milk yields. | Garcia Podesta<br>Odongo<br>Viljoen |
| SRL/5/041 | Maximizing Productivity on Goat Farms through Cost-Cutting and DNA-Based Technology in Selection for Breeding<br>**Objective**: To improve the productivity of goats of small-holder farmers in Sri Lanka, by introducing new strategies such as supplementary feeding, improved management practices and disease control and by transferring genetic technologies to assist in proper selection of superior breeding animals. | Garcia Podesta<br>Odongo<br>Viljoen<br>Malek |
| SUD/5/028 | Epidemiology and Control of Snail-borne Diseases in Irrigated Areas<br>**Objective**: The overall objectives of the project are to increase animal production, and maintain healthy and productive herds in irrigated areas by controlling snail-borne diseases. | Unger |
| SUD/5/029 | The Characterization and Quality Assured Production of an Attenuated Theileria Annulata vaccine<br>**Objective**: To protect cattle against tropical theileriosis through vaccination in order to improve animal health and reduce reliance on acaricidal/pesticide tick control. More specifically, to establish quality-assured procedures and protocols for T. annulata cell culture vaccine production. | Unger |
| SUD/5/031 | Setting up a National Network for the Control of Livestock Diseases that affect Exports<br>**Objective**: To establish capacity to diagnose Brucellosis in ruminants to improve food safety and secure animal exports. | Unger |
| TAD/5/003 | Diagnosis and Control of Brucellosis in Cattle, Sheep and Goats<br>**Objective**: To improve diagnosis of brucellosis in cattle, sheep and goats in order to prevent the spread of the disease among animals and the human population in Tajikistan. | Crowther |
| UGA/5/028 | Improving the Capacity for Diagnostic of Animal Diseases<br>**Objective**: To strengthen the diagnostic capacity of the Diagnostics and Epidemiology Laboratory of the Ministry of Agriculture, Animal Industry and fisheries to monitor and control transboundary animal diseases of importance (e.g. CBPP, FMD, AI, Rabies, Brucellosis and RVF) to Uganda. | Viljoen<br>Unger |
| URT/5/025 | Support for the Delivery of Artificial Insemination services<br>**Objective**: The sustainable intensification of milk and meat through the provision of efficient and reliable AI services. | Garcia Podesta |
| YEM/5/006 | Quality Management for Upgrading Animal Disease Control<br>**Objective**: To improve the management of diagnostic testing for livestock diseases in Yemen, leading to increased assurance of results in aiding control programmes. | Crowther<br>Viljoen |
| ZAI/5/015 | Upgrading Laboratory Services for Diagnosis of Animal Diseases<br>**Objective**: Control and eradication of livestock transboundary diseases or other epizootics through the laboratory investigations using nuclear and related technologies. | Unger |

| TC Project | Description | TO |
|---|---|---|
| ZAM/5/025 | Development of Feeding Strategies for Smallholder Dairy Animals in Njolwe and Palabana Dairy Tenant Schemes<br>**Objective**: To improve household food security and income generation among small scale farmers through increased production and marketing of livestock by developing sustainable feeding and breeding strategies based on increased use of locally available resources. | Garcia Podesta Odongo |

# Publications

## Recently published

### Guidelines for Sustainable Manure Management in Asian Livestock Production Systems

IAEA-TECDOC-1582


This publication was produced under an IAEA Technical Cooperation Project and includes information about: trends in livestock production and animal manure management in Asia, a systems approach to sustainable manure management, production and composition of manure, manure management during housing and storage, processing and handling of manure to reduce pollution and improve nutrient utilization, and the field application and utilization of manures. It also reports the main conclusions and recommendations from the experts' meeting. This publication is aimed at all levels of administrative and technical personnel involved in the management of manure in livestock systems and environmental sustainability in Asia, including ministries of agriculture, livestock and environment, directorates of livestock and veterinary services, local authorities responsible for livestock development services, faculties of agriculture and animal, plant and soil sciences, and institutes involved in environmental sustainability. It is also a useful resource for teachers and students in faculties of veterinary and animal sciences, and soil and plant sciences. IAEA-TECDOC-1582, 2008, ISBN 978-92-0-111607-9, English.

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## In Preparation

### Managing Prenatal Development to Enhance Livestock Productivity

Responsible Technical Officer: Nicholas Odongo

The need for a book dealing with managing prenatal development to improve livestock productivity was identified during a Consultants meeting on 'Research Needs for Improvement of Livestock Productivity in Developing Countries through Manipulation of Nutrition in Utero', held in October 2005.

There is a growing demand worldwide for livestock products and the role of developing countries in meeting this demand will continue to increase. The current production systems will come under increasing pressure because of the global access to feed and feed resources and other environmental challenges. The reproductive female will be under the most pressure in the future because she will be expected to reproduce consistently, and at the very least, annually. The female will also face nutritional and other environmental challenges in meeting the developmental needs of the embryo and foetus throughout gestation and during the preweaning period. Therefore, the foetus is exposed to various challenges that are mostly, but not exclusively, of a nutritional nature. The question is whether these challenges impact on foetal development and subsequent health, growth, reproductive and lactational characteristics of the offspring.

The objectives of this book are to provide a quantitative assessment of the role of, and current state of understanding of the mechanistic basis to, environmental plasticity in producing healthy and productive livestock. The book will contain review papers covering all the key livestock species as well as chapters covering relevant information on non-livestock species.

### *In vitro* screening of plant resources for extranutritional attributes in ruminants: nuclear and related methodologies

Responsible Technical Officer: E. Nicholas Odongo

This document is the outcome of a meeting between the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and Writtle College titled 'Alternative feed resources: a key to livestock intensification in developing countries' held on 14/15 September 2006. The meeting planned to produce a manual on *in vitro* methodologies used to screen flora for bioactive compounds. The manual would compile the processes used by experts invited to the meeting from the areas of nutrition, screening native plants for bioactive com-

pounds for animal health and production, ruminal molecular biology, gut parasitism, and feeding behaviour to develop a research and technical programme for future plant screening techniques to improve livestock production in MS.

The manual would assist developing countries in the trend towards intensification of livestock production which has both risks and opportunities. The potential opportunities are the flow-on benefits to the local economy and producers and the potential risks are the flow-on costs to the centralization of feed resources, livestock health and welfare, disease transmission and human health (through increased chemical and nutrient pollution). Intensification of livestock production can also lead to higher levels of greenhouse gas emissions and a localization or concentration of nutrients and pollution of waterways, increased chemical and drug use to overcome the increased risk of disease transmission thus putting pressure on the local feed and reproduction management systems.

There is also growing global pressure from consumers for sustainable production systems, ones where high quality and safe products are produced efficiently with minimal impact on the environment and human health. Developing countries will also be under similar pressures the developed countries are currently under to limiting the input of, and finding 'natural' alternatives for, drugs and chemicals, thus exploring alternative sources of feed, reducing methane production and addressing animal feeding, health and welfare issues; in other words maximizing productivity from local resources in a clean, green and ethical way.

This manual will provide the methodologies for MS to screen their flora for alterative feed additives to improve livestock productive and reduce environment impact. The techniques outline in the manual will also allow the MS, their scientist and local communities to formally capture and value traditional knowledge and the genetic diversity of their flora.

The following broad topics will be included in the document:

- Challenges in extrapolating *in vitro* data to in vivo evaluation of plant resources
- *In vitro* screening of feed resources for efficiency of microbial protein synthesis
- Assessing antiprotozoal agents
- Screening plants and plant products for methane inhibitors
- Screening plants for the antimicrobial control of ruminal acidosis.
- *In vitro* methods for screening plant products for direct activity against ruminal gastrointestinal nematodes.

This publication will be of interest to MS wishing to improve livestock productivity, improve utilization of digestible nutrients, reducing the use of drugs and chemicals in livestock production, and reducing environment impact of livestock to meet national and international requirements for trade in food and food products. The target audience/readership include current, and future TCP and CRP counterparts, laboratory managers and staff, fellows and training course participants ay regional and inter-regional courses, enthobotanists, enthoveterinarians, and tertiary training institutions in livestock production and plant secondary compounds.

## Veterinary Diagnostic Real-time PCR Handbook

Responsible Technical Officer: Gerrit Viljoen

The uses of nucleic acid-directed methods have increased significantly in the past five years and have made important contributions to disease control country programmes for improving national and international trade. These developments include the more routine use of PCR and real-time PCR as diagnostic tools in veterinary diagnostic laboratories. However, there are many problems associated with the transfer and particularly, the application of this technology. These include lack of consideration of: the establishment of quality-assured procedures, the required set-up of the laboratory and the proper training of staff. This can lead to a situation where results are not assured.

This book will give a comprehensive account of the practical aspects of real-time PCR and strong consideration will be given to ensure its optimal use in a diagnostic laboratory environment. This includes the basic principles, setting-up of a real-time PCR laboratory; Good Laboratory Practice and Standard Operating Procedures; Diagnostic Implementation, Execution and Interpretation and Problem Solving. Examples of Standard Operating Procedures as used in individual specialist laboratories and an outline of training materials necessary for real-time PCR technology transfer will be presented. The difficulties, advantages and disadvantages in PCR and real-time PCR applications will be explained and placed in context with other test systems.

Emphasis will be placed on the use of real-time PCR for detection of pathogens, with a particular focus on diagnosticians and scientists from the developing world. It is hoped that this book will enable readers from various disciplines and levels of expertise to better judge the merits of real-time PCR and to increase their skills and knowledge in order to assist in a more logical, efficient and assured use of this technology.

The following major areas will be included in the document:

- Traditional PCR
- Real-Time PCR- The Basic Principles
- Diagnostic Real-Time PCR Applications (e.g., TaqMan, Molecular beacons, Primer-Probe Energy Transfer methods, others)
- Novel PCR techniques aimed for diagnostic use
- Laboratory automation, molecular diagnostics
- Real-time PCR analysis and interpretation/statistical analysis
- Real-time PCR laboratory set-up and quality assurance management of the diagnostic labora-

tory and the diagnostic test (Including Quality assurance and validation of molecular assays).

This publication will be of interest to the Member States wishing to improve disease control country programmes for improving national and international trade. The recipients will include current, past and future TCP and CRP counterparts, laboratory managers and staff, fellows and training course participants at regional, inter-regional courses, and tertiary training institutions in livestock production.

## Integrated Approach for Improving Livestock Production Using Indigenous Resources and Conserving the Environment

Responsible Technical Officer: E. Nicholas Odongo

Livestock farming is very important in Asia and the pacific region as a source of livelihood for resource poor farmers, i.e. for provision of food and food products and as a source of income. However, livestock productivity in many countries is below their genetic potential because of inadequate and imbalanced feeds and feeding, poor reproductive management and animal diseases which is exacerbated by lack of effective support services, such as animal husbandry extension, artificial insemination (AI) and/or veterinary services.

The International Atomic Energy Agency (IAEA) and the Regional Cooperative Agreement for Asia and the Pacific Region (RCA), with technical support of the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture, implemented a Technical Cooperation (TC) project entitled 'Integrated approach for improving livestock production using indigenous resources and conserving the environment' (RAS/5/044). The specific objectives of this project were: (a) to improve animal productivity and decrease discharges of selected greenhouse gases (GHG; methane and carbon dioxide) and selected nutrients (nitrogen and phosphorus) into the environment; and (b) to identify and adopt better breeding strategies to improve animal productivity through the use of better selection criteria for offspring from cross-breeding programmes, optimum utilization of appropriate indigenous cows, benchmarking for growth and reproduction, and improving procedures for management, nutrition and healthcare programmes in dairy farms.

The first meeting of the project was hosted by the Institute of Agricultural Environment and Sustainable Development of the Chinese Academy of Agricultural Sciences (CAAS), Beijing, China from 4 to 8 April 2005. It was attended by 23 project counterparts from 12 RCA Member States (Bangladesh, China, India, Indonesia, Myanmar, Mongolia, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam) and was supported by 3 IAEA experts and 2 IAEA Technical Officers (TO).

The final project meeting was held in Jakarta, Indonesia from 5 to 9 May 2008 hosted by the National Nuclear Energy Agency of Indonesia (BATAN) to: (a) review results (animal nutrition and reproduction/breeding) obtained in each MS; (b) assess the achievements, outputs and potential outcomes; (c) draw conclusions and recommendations; (d) list the activities that should be continued using national and other resources; and (e) prepare manuscripts emanating for publication in an IAEA-TECDOC. The meeting was supported by 2 IAEA experts (Dr. Karen Marshall of Australia and Prof. Singh Nanda of India) and 2 IAEA TO (A. Schlink for nutrition and O. Perera for reproduction/breeding).

This publication contains research results presented by scientists during the final review meeting. Briefly, the participating MS have developed strategies to reduce methane production and conserve the environment. The feeding strategies have resulted in increased weight gains and milk production in dairy animals. Increased milk yields of approximately 25% were observed in Bangladesh and in the Philippines. Bangladesh, China, Indonesia and Myanmar reported increased average daily weight gains ranging from 15 to 70%. The reduction in methane production due to adoption of the new feeding strategies in Bangladesh, China Indonesia, Pakistan and Thailand ranged from 15 to 70%. Bangladesh, Indonesia, Pakistan and Sri Lanka have also reported increased N and P content of manure which has resulted in 25 to 40% increase in rice and fodder yields. Most of the participating countries have disseminated the knowledge for efficient manure management to end users. Selected farmers (Lead Farmers) have been trained on the new feeding strategies.

Almost all the participating MS have also achieved genetic improvement in their livestock through different reproductive techniques. For example, India and Sri Lanka through use of synchronization programmes and insemination with genetically superior semen, Bangladesh through IVF and ETT programmes and Myanmar, Philippines, Indonesia, Thailand through crossbreeding programmes. Most of the MS have designed and applied the criterion for selection of better heifers e.g. in India selection is based on weight gain and parents performance while in the Philippines additional parameters like milk composition have been taken into consideration. A laboratory protocol for IVM, proper semen preparation as well as Cryobanking of semen, IVF of IVM oocytes was established in Bangladesh, Sri Lanka and Indonesia. All the participating countries have included improved reproductive techniques and nutritional supplementation strategies to improve production and reproduction of local and crossbred cattle/buffaloes.

The contributions of the experts associated with RAF/5/044 have been incorporated in the report and it is hoped that this publication will help stimulate further research and development into ways of improving the efficiency and productivity of livestock, leading to higher incomes and livelihoods for smallholder farmers.

## Economic Impact of Targeted Interventions to Improve Productivity of Peri-Urban Small-holder Dairy Farms

Technical Officer: Mario Garcia Podesta

This document was produced under an IAEA Coordinated Research Project entitled 'Integrated Approach for Improving Small Scale Market Oriented Dairy Systems', with technical support of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. It details the results obtained by project counterparts from interventions to improve animal productivity by overcoming the most important contraints identified during Participatory Rural Appraisals made and Economic Opportunity Surveys performed in direct interaction with stakeholders. The publication presents both the results of case studies in which the interventions were applied and methods for evaluating their economic impact. The publication is intended for livestock specialists involved in the management of dairy production services for cattle farmers in Asia, including those in Ministries of Agriculture/Livestock, Departments of Livestock and Veterinary Services, AI centres, public and private veterinarians and consultants.

## Guidelines for Selection and Breeding of Cattle and Buffalo in Asia

Technical Officer: Mario Garcia Podesta

This publication contains the outcome of a Consultants Meeting conducted under the framework of a regional IAEA/RCA project on 'Integrated approach for improving livestock production using indigenous resources and conserving the environment' (RAS/5/044). The need for such a document was identified during the first planning meeting of the project. The topics covered are all relevant to the IAEA programme, including artificial insemintion (AI) nuclear techniques on livestock reproduction and breeding and to the activities being undertaken by project counterparts with support from national and regional projects in Asia.

The topics covered include: information about trends in livestock production and cattle breeding management in Asia; the important traits for dairy and beef cattle, their selection criteria, and breeding objectives; proposed systems for operating a cattle breeding and genetic improvement programme in Asia; and an overview of current and future technologies for improvement of cattle breeding.

## Instant Testing and Reporting Systems

A paper is to be submitted on Instant Testing and Reporting Systems to the OIE. The Joint FAO/IAEA Division is actively supporting the system which comprises highly mobile rugged and operator fool proof devices to perform diagnostics with defined diagnostic specificities ad sensitivities which can instantly send results back from the field to a central control point. In this way real-time diagnosis can be made. The devices use variants of the PCR and instant extraction and analysis of samples, thereby avoiding the problems of sample storage and transport- often the most damaging feature to molecular tests. The system is at the heart of the CRP D3.20.25 involving the rapid diagnosis of avian influenza. The devices will be validated in reference laboratories and then in the field. Such systems offer the way forward to improving early warning of disease spread and should revolutionize diagnosis in developed and developing countries.

## CD-ROMs

A CD-ROM is available dealing with training material for the diagnosis of rinderpest and for the preparation for the OIE pathway. It was produced under an IAEA Technical Cooperation project RAF/0/013 ICT based training to strengthen LDC capacity. Contact John Crowther at j.crowther@iaea.org for further information.

A new batch of CDs with a training package to help artificial insemination (AI) technicians to improve the performance of AI and field services provided to farmers was produced for users with a slow internet connection and is now available through the APHS. It is also accessible from the AP&H Section website:
http://www-naweb.iaea.org/nafa/aph/index.html

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