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Special Issue



5th Pan Commonwealth Veterinary Conference
21 - 25 March 2011, Accra, Ghana

*Theme: The Role Of Veterinarians And Livestock Farmers In Food Security
And Poverty Alleviation*

PROCEEDINGS

Edited by

Dr. S. Abdul Rahman
Secretary, CVA

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“5th Pan Commonwealth Veterinary Conference”
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European Commission



World Society for the Protection of Animals



Australian Government
AusAID

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healthy working animals
for the world's poorest communities

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PO Box 143, Legon, GHANA

Tel: (233 21) 772553 (O); 782177 (R)

Fax: (233 21) 776021

Email: suuire@hotmail.com

SECRETARY

Dr. S. Abdul Rahman

123, 7th 'B' Main Road, 4th Block (West)

Jayanagar, Bangalore 560 011, INDIA.

Tel/Fax: (91 80) 26635210

Email: shireen@blr.vsnl.net.in

shireencva@gmail.com

TREASURER

Dr. Peter Thornber

Manager, AAWS & Communications

Agricultural Productivity Division, DAFF

GPO Box 858, Canberra ACT 2601. AUSTRALIA

Tel: 02 6272 3925, Mobile: 0407207986

Email: peter.thornber@daff.gov.au

IMMEDIATE PAST PRESIDENT

Dr. Robin Yarrow

GPO Box 15411

Suva, FIJI.

Fax: (679) 3384980

Email: yarrow@connect.com.fj

PROGRAMME DIRECTOR

Dr. Robert McCracken CBE

The Old Gallery, 1 Milford Road, Duffield, Belper

Derbyshire DE56 4EL, UNITED KINGDOM

Tel: (44 0) 1332 843 130, Mob: (44 0) 7766 355 465

Email: hbmccracken@btinternet.com

REGIONAL REPRESENTATIVES

ASIA

Dr A.A. Ramzee

148-A, Ali Block

New Garden Town

Lahore 54000, PAKISTAN

Tel: (92 42) 583 4609

Fax: (92 42) 586 9606

Mobile: 03008433960

Email: ramzee@brain.net.pk

EAST/ CENTRAL/ SOUTHERN AFRICA

Dr Henry B. Magwisha

Central Veterinary Laboratory

PO Box 9254, Dar es Salaam

TANZANIA

Tel: (255) 22 2861152

Fax: (255) 22 2864369

Email: hbudodi@yahoo.com

AUSTRALASIA/ OCEANIA

Dr. Siosifa Fifita

15 Wyndham Street

Ashhurst, Palmerston North

NEW ZEALAND

Tel: (64) 09 439 8665

Mobile: (64) 021 172 1535

Email: Joseph.Fifita@nzfsa.govt.nz

siof137@xtra.co.nz

WEST AFRICA

Dr Olatunji Nasir

C/o Truthmiles Animal Hospital

55, Akinola, Cole Crescent

Off Adeniyi Jones Avenue

Ikeja, Lagos, NIGERIA

Tel: (234 1) 8121590

Mobile: (234) 8033061214

Email: truthmiles@yahoo.com

CANADA CARIBBEAN

Dr Keith G. Campbell

17 Tuscany Glen Rd. NW

Calgary, Alberta

CANADA T3L 2T5

Tel: (1 403) 7160352; (402) 9090885

Email: mb207425@mts.net

U.K. / MEDITERRANEAN

Dr Karen Reed

The Brooke, 30 Farrington Street

London EC4A 4HH, UNITED KINGDOM

Tel. +44 (0) 20 7653 5837

Fax. +44 (0) 20 3012 0156

Email: Karen.Reed@thebrooke.org

5th Pan Commonwealth Veterinary Conference

21 - 25 March 2011, Accra, Ghana

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Scientific Sessions

TUESDAY, 22 MARCH 2011

08.00 am – 05.00 pm MAIN HALL	Plenary Session	Chairperson: Dr. Richard Suru-In Co-Chairperson: Dr. Bob Adenomon Rapporteur 1: Dr. David Okong Rapporteur 2: Dr. Josephine-Ann Obo
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WEDNESDAY, 23 MARCH 2011

08.30 am – 06.00 pm CONFERENCE HALL 1	Session 1: Animal Welfare Workshop	Chairperson: Dr. David Okong Co-Chairperson: Dr. Peter Thomsen
08.30 am – 01.00 pm MEETING HALL 1	Session 2: The Future of Livestock in Africa	Chairperson: Dr. Kwame Boa-Adomako Co-Chairperson: Prof. G. K. Odiako Rapporteur 1: Dr. Isaac Okongbo Rapporteur 2: Dr. Festus Okonob
08.30 am – 01.00 pm MEETING HALL 2	Session 3: Veterinary Education	Chairperson: Dr. Tjard Jansen Co-Chairperson: Dr. J. K. Taylor Rapporteur 1: Dr. Michael Boshuys Rapporteur 2:
01.00 pm – 05.00 pm MEETING HALL 1	Session 4: The Role of Parasites in African Farming Systems	Chairperson: Dr. Edoia Yawson Co-Chairperson: Dr. R. Pullen Rapporteur 1: Dr. Michael Boshuys Rapporteur 2: Dr. Douglas O. Okong
01.00 pm – 05.30 pm MEETING HALL 2	Session 5: One World One Health/Well-Being	Chairperson: Dr. Tracy Adenomon Co-Chairperson: Dr. William Ouedraogo Rapporteur 1: Dr. David Okong Rapporteur 2: Dr. Douglas O. Okong

THURSDAY, 24 MARCH 2011

08.30 am – 05.00 pm CONFERENCE HALL 1	Session 6: Rubrics Workshop	Chairperson: Dr. Lea Koopf Co-Chairperson: Dr. Deborah Briggs
08.30 am – 01.00 pm MEETING HALL 1	Session 7: Food Safety and Security in Agriculture	Chairperson: Dr. Keith Campbell Co-Chairperson: Dr. K. O. Odiako Rapporteur 1: Dr. Michael Boshuys Rapporteur 2: Dr. Josephine-Ann Obo
08.30 am – 06.00 pm MEETING HALL 1	Session 8: Workshop on Working Animals	Chairperson: Dr. Kaseo Reed Co-Chairperson: Dr. Jay Mitchell
01.00 pm – 05.00 pm MEETING HALL 1	Session 9: Companion Animals	Chairperson: Dr. Gassab Bada Co-Chairperson: Prof. F. K. Turekwa Rapporteur 1: Dr. Douglas O. Okong Rapporteur 2: Dr. David Okong



5th Pan Commonwealth Veterinary Conference 21 – 26 March 2011, Accra, Ghana

**Theme: The Role of Veterinarians and Livestock Farmers in Food Security And
Poverty Alleviation**

PROGRAMME

Wednesday, 23rd March	
at a Hotel in Ghana	
Wednesday, 23rd March	
Registration for the Medical Program commencing at 9.00 am at the Hotel in Ghana Course of Medical Program for the day commencing at 9.00 AM at the Hotel in Ghana	
Wednesday, 24th March	
Course of Medical Program commencing at 9.00 am at the Hotel in Ghana Course of Medical Program for the day commencing at 9.00 AM at the Hotel in Ghana	
08.00 – 08.30 am	Registration for the day commencing at 9.00 am at the Hotel in Ghana
08.30 – 09.30 am	Medical Program commencing at 9.00 am at the Hotel in Ghana Opening Ceremony: Hon. Minister of Health, Ghana Inauguration of the 5 th Pan-Commonwealth Veterinary Conference, 21-26 March 2011 at the Hotel in Ghana

SCIENTIFIC PROGRAMME

Wednesday, 23rd March	
MAIN HALL	
	PROCEEDINGS SESSION
08.00 – 08.30 am	Registration for the day commencing at 9.00 am at the Hotel in Ghana
08.30 – 09.30 am	Opening Ceremony: Hon. Minister of Health, Ghana Inauguration of the 5 th Pan-Commonwealth Veterinary Conference, 21-26 March 2011 at the Hotel in Ghana
09.30 – 10.30 am	Scientific Program commencing at 9.00 am at the Hotel in Ghana
10.30 – 11.30 am	Break
11.30 – 12.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
12.30 – 01.30 pm	Lunch
01.30 – 02.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
02.30 – 03.30 pm	Registration for the day commencing at 9.00 am at the Hotel in Ghana
03.30 – 04.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
04.30 – 05.30 pm	Break
05.30 – 06.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
06.30 – 07.30 pm	Registration for the day commencing at 9.00 am at the Hotel in Ghana
07.30 – 08.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
08.30 – 09.30 pm	Registration for the day commencing at 9.00 am at the Hotel in Ghana
09.30 – 10.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
10.30 – 11.30 pm	Registration for the day commencing at 9.00 am at the Hotel in Ghana
11.30 – 12.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
12.30 – 01.30 pm	Break
01.30 – 02.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
02.30 – 03.30 pm	Registration for the day commencing at 9.00 am at the Hotel in Ghana
03.30 – 04.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
04.30 – 05.30 pm	Break
05.30 – 06.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
06.30 – 07.30 pm	Registration for the day commencing at 9.00 am at the Hotel in Ghana
07.30 – 08.30 pm	Scientific Program commencing at 9.00 am at the Hotel in Ghana
08.30 pm	Registration for the day commencing at 9.00 am at the Hotel in Ghana

PROCEEDINGS OF THE 5th PAN-COMMONWEALTH VETERINARY CONFERENCE

SESSION TITLE		SESSION TITLE		SESSION TITLE	
<p>10:30 AM - 12:00 PM Registration and Welcome Reception Venue: [Venue Name] Contact: [Contact Info]</p>		<p>10:30 AM - 12:00 PM [Session Title] Venue: [Venue Name] Contact: [Contact Info]</p>		<p>10:30 AM - 12:00 PM [Session Title] Venue: [Venue Name] Contact: [Contact Info]</p>	
<p>12:00 PM - 1:30 PM Lunch Break Venue: [Venue Name]</p>	<p>12:00 PM - 1:30 PM [Session Title] Venue: [Venue Name]</p>	<p>12:00 PM - 1:30 PM [Session Title] Venue: [Venue Name]</p>	<p>12:00 PM - 1:30 PM [Session Title] Venue: [Venue Name]</p>	<p>12:00 PM - 1:30 PM [Session Title] Venue: [Venue Name]</p>	<p>12:00 PM - 1:30 PM [Session Title] Venue: [Venue Name]</p>
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PROCEEDINGS - DAY TWO (15th September)

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Session 1000 The National Meeting, Wednesday, 28th March and Thursday, 29th March

Session 1000 National Meeting, Wednesday 28th March and Thursday 29th March 8:30 - 4:30 pm on Wednesday, 28th March and Thursday 29th March	
1.	Practicality: Design of a new spray gun for the application of Hg ²⁺ in the field - Dr. J. A. O. Oduro, Hg²⁺
2.	Practicality: Design of a new spray gun for the application of Hg ²⁺ in the field - Dr. J. A. Oduro, Hg²⁺
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15.	Practicality: Design of a new spray gun for the application of Hg ²⁺ in the field - Dr. J. A. Oduro, Hg²⁺
16.	Practicality: Design of a new spray gun for the application of Hg ²⁺ in the field - Dr. J. A. Oduro, Hg²⁺
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30.	Practicality: Design of a new spray gun for the application of Hg ²⁺ in the field - Dr. J. A. Oduro, Hg²⁺

SESSION 1000	SESSION 1000
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Proceedings

Foreword

5th Pan Commonwealth Veterinary Conference

21-25 March 2011: The Role of Veterinarians and Livestock
Farmers in Food Security and Poverty Alleviation

We are pleased to introduce on behalf of the European Commission and the Food and Agriculture Organization of the United Nations (FAO) the Proceedings of the Fifth Pan Commonwealth Veterinary Conference. This event offered the opportunity to the European Commission and the Commonwealth Veterinary Association to join efforts and contribute on the exchange of knowledge on issues of interest for veterinarians worldwide.

The conference highlighted the role of animals and livestock production in improving people livelihood, especially in less privileged areas and focused on major topics such as food safety and security, advances in veterinary science, animal health and welfare and the important role of working animals.

Both the European Commission and the FAO recognise the contribution of veterinarians and the important role of the Commonwealth Veterinary Association in the development of a responsible livestock sector. Veterinarians are invested with public trust and have the responsibility to act as guardians and advocates of animal health and therefore implicitly human health.

The European Commission and FAO have contributed to the development of the One Health programme by highlighting the strong interlink between human and animal health. Moreover, good animal health and nutrition are at the basis of animal welfare and the livelihoods of the people who depend on those animals.

The Commission and FAO urge to recognize widely the value of animal welfare and its positive impact on livestock production and on the livelihoods of farmers worldwide. The Proceedings of this conference are a relevant source of information in this regard and a relevant tool to raise awareness on valuable issues in the livestock sector. They address the importance of continuing the efforts towards food security and poverty alleviation by combating animal diseases, ensuring public health and integrating animal welfare in development projects especially in the less privileged areas when it contributes to the food chain productivity and sustainability.

We would like to thank all people who have contributed to the success of the Conference and the authors of the papers that are making up this publication.

The contributions to the Conference by the Commonwealth Veterinary Associations and other key stakeholders, such as animal health and welfare NGOs, as well as important intergovernmental organisations like the FAO and the World Organisation for Animal Health (OIE) are making this publication a proof of a shared commitment that will lead to an improvement of animal and human health and animal welfare worldwide.

Bernard Van Goethem

Berhe G. Tekola

Inaugural Address by

Dr Bernard Vallat

Director General - World Organisation for Animal Health (OIE), Paris, France

Your Excellency, Honourable Minister of Land and National Resources,
Representatives of international Organisations,
Honourable President of the Commonwealth Veterinary Association, of the World Veterinary Association and of the Africa Veterinary Association,
Honourable President of Ghana Veterinary Association
Dear OIE Delegates,
Distinguished guests and participants
Dear Colleagues
Ladies and Gentlemen,

It is a great honour for me to participate in that inaugural Session of the 5th Pan Commonwealth Veterinary Conference on behalf of the OIE President and our Member Countries.

I welcome the title of your Conference on the “role of veterinarians and livestock farmers in food security and poverty alleviation”. It is one of the key objectives within the 5th Strategic Plan of the OIE voted by our Members in May 2010.

Other key topics of your Conference, such as rabies control, animal welfare, role of wildlife, veterinary education and aquaculture are also on the heart of our new Strategic Plan.

So a lot of synergies between OIE objectives and your activities during this Conference can be expected and this is really good news to see that the world veterinary community is pushing in the same direction to address concerns of our society at global level.

The unity of the veterinary profession at global level is becoming more and more visible. The continuing communication between the different components of veterinary profession allows the provision of harmonised messages. This reinforces the credibility and efficiency of the communication directed at policy makers and the public and is why the OIE is working more and more with national and global veterinary Associations such as World Veterinary Association, Commonwealth Veterinary Associations and many others.

The OIE and I are also involved in the celebrations being organised for the 250th birthday of the veterinary profession because it is a unique opportunity to communicate globally on the usefulness of our profession. This opportunity is reinforced by the fact that 2011 will also be the year of the official declaration by the OIE and FAO of a world free of Rinderpest. This official announcement will be made during the World Assembly of the OIE in Paris, Wednesday 25th of May after the vote of our Members and in Rome the day 29th of June by FAO.

The conjunction of these key events is very useful for reinforcing the credibility of veterinary profession and its partners, including farmers, as key providers of benefits to society at large.

The diversity of the veterinary profession is also a great wealth and an advantage for all veterinarians involved in different sectors of activities. Let me remind you that the official definition of Veterinary Services of the OIE includes veterinarians working full time for the Government but also private practitioners involved in passive and active disease surveillance through their professional activities and their obligation to notify infectious diseases after detection.

It is more and more evident that the previous competition in some countries between public and private veterinarians is becoming obsolete and that the health of veterinary public sector is beneficial to the health of veterinary private sector and vice versa.

However more should be done for a better recognition of the benefits of veterinary profession for society. For that, one important step is to ensure a global quality of the initial training of veterinarians in all countries, to be sure that somebody using a title of veterinarian has indeed received appropriate training.

This is a very ambitious objective because many countries in the world do not control the quality and the content of veterinary education and recognise diploma without sufficient constraints given to the veterinary education establishments. This policy could progressively undermine the public's image of our profession worldwide.

This is one of the reasons why the Conference on veterinary education to be held in Lyons in May in the framework of Vet2011 will be important, as well as a Resolution to be proposed to our World Assembly on that topic, dealing with the basic core curriculum of veterinarians proposed to the OIE by a group of deans from all regions of the world.

Honourable participants, let me confirm that this kind of Conference is very useful and let me congratulate the Committee of the Commonwealth Veterinary Association and our colleagues of Ghana for organising it.

I also hope that a majority of participants will be able to participate in the World Veterinary Congress in South Africa in October this year. I am happy to note that the Congress will be in Africa, one year after the football World Cup and I confirm that the OIE will strongly support and be one of the sponsors of the event.

I wish you a successful Conference

Thank you for your attention

Message from World Health Organisation (WHO)

The World Health Organisation (WHO) congratulates the organizers of the 5th Pan Commonwealth Veterinary Association Conference and the Government of Ghana for hosting this conference. WHO regrets that it could not be represented but thanks the organizers for having accepted to read out a message on its behalf.

WHO is increasingly paying attention to the work being carried out at the animal-human interface. This is where humans come into direct or indirect contact with animals, their products or their environments and consequently where the greatest risk for emergence and effective transmission of a zoonotic disease occurs. WHO's corporate vision is that of "a world capable of effectively managing the public health risks attributable to zoonoses" whether those zoonoses are new, emerging or endemic and neglected.

Forecasting, detecting, preventing, containing and eliminating zoonotic disease is a very complex and multifaceted task, which has to take into account a large variety of drivers which should be understood and jointly tackled by specialists particularly from the veterinary and medical professions. The main drivers of zoonotic disease emergence and spread are evolving ecological conditions and climate change, microbes and hosts adaptation, animal demographics, human population growth and behaviour, international travel and trade, food production/distribution practices and consumer's habits.

The veterinary profession is expected to play a fundamental role each time the emergence of a zoonotic disease and its spread is or is likely to be mostly influenced by the rapid increase in demand for livestock products, the intensification of agricultural systems, and the lengthening and increasing complexity of animal products market chains.

Risk management for zoonotic diseases at the human-animal interface needs to cover a range of approaches: from prevention to containment, control and elimination whenever possible. Any overarching strategy will need to take into account broad social and cultural diversity, and be adaptable to a range of settings, e.g. developed and developing countries, urban and rural communities.

Addressing zoonotic risks requires interdisciplinary and intersectoral cooperation, based on strong core competencies, knowledge and effective partnerships, especially between human and animal disease prevention, detection and response efforts. WHO convinced this meeting will contribute to strengthening joint veterinary-medical activities at the human-animal interface, wish the participants and organizers a successful conference and fruitful discussions.

Dr François-Xavier Meslin

Team Leader - Zoonotic Diseases (Neglected) (NZD)

Department of Neglected Tropical Diseases (NTD)

WHO Headquarters, Geneva

Switzerland

Plenary Session

The Future of Livestock in Africa

Kwame Boa-Amponsem

*Animal Research Institute
Ghana*

Livestock Agriculture in Africa affects profoundly the health, the livelihoods and the environment of the peoples of this continent. In several Regions of this continent, demand for livestock products has outstripped domestic production. This demand is expected to be fueled further by population growth, urbanization and income growth in these nations. (Delgado et al., 1999, FAO, 2003). Massive imports of livestock products into these countries has had and continue to exert adverse consequences on initiatives to develop infrastructure to increase domestic production in these nations.

The paper reviews the livestock production systems in Africa with a view to assessing their potential to respond to the expected surge in demand for food of animal origin. The paper further provides an analysis of the options available including the application of modern technologies. The expected expansion in the supply systems needs to take account of environmental degradation. Therefore improvement in animal productivity, with consequent reduction in herd size will come to the fore, requiring the contribution of various skills and expertise in several fields.

The paper concludes that the future of livestock in Africa lies in the ability to control the huge market expected in the future

Emerging Disease Threats to Wildlife

Andrew Cunningham

Institute of Zoology

*Zoological Society of London, Regent's Park, London NW1 4RY
United Kingdom*

A recent increase in infectious disease emergence in humans is well documented, but less well known is an increasing recognition of emerging disease threats to wildlife. These parallel phenomena are, in part, due to increased vigilance and investigation, but also are due to common drivers. Anthropogenic environmental change and the globalisation of trade and travel are important drivers of disease emergence in livestock and humans and these same factors drive the emergence of infectious disease threats to wildlife. This can happen, for example, via the human-assisted transport and introduction of new pathogens to naïve host populations, or via the breakdown of ecological boundaries, *e.g.* through the introduction of novel vectors.

An early example was the co-introduction of mosquitoes, avian malaria and avian pox to Hawai'i by early traders. This led to catastrophic declines of the naïve, native avifauna and to the extinction of multiple species of endemic honeyeaters. More recently, a global pandemic of amphibian chytridiomycosis, caused by the fungus, *Batrachochytrium dendrobatidis*, has been driven by international trade. This disease is now a major cause of amphibian population declines and species extinctions worldwide. The introduction of West Nile virus to North America has negatively impacted multiple wildlife species across the continent as well as threatening domestic animal and human health. The protozoan parasite, *Trichomonas gallinae*, a long-recognised pathogen of columbids and birds of prey, has recently jumped hosts and is now causing epidemic mortality of passerine birds in Europe. Within two years of its initial emergence, finch trichomonosis had caused British greenfinch populations to decline by up to 35%. It has been hypothesised that the species jump was facilitated by the provisioning of garden birds, bringing together unnaturally high wild bird densities and species complements over prolonged periods.

As with diseases of humans and livestock, emerging infectious diseases of wildlife can spread, ultimately threatening much larger areas and wildlife populations than those in which they initially emerge. There is an urgent need for further research into the impact of anthropogenic change on the ecology of wildlife disease and of the possible consequences for domestic animals and humans.

Control of Neglected Zoonoses for Poverty Alleviation: A New Paradigm for One Health?

Anna L. Okello and Susan C. Welburn

College of Medicine and Veterinary Medicine

The University of Edinburgh

Chancellors Building, 49 Little France Crescent; Edinburgh EH16 4SB

United Kingdom

The concept of comparative medicine is not new; however the onset of the 21st century has seen an increased profile in the execution of its principles, known today in a wider context as “One Health”. The appearance over the past decade of emerging zoonoses such as Highly Pathogenic Avian Influenza, Nipah Virus and SARS have called for closer collaboration between veterinary, medical and environmental disciplines in order to improve disease surveillance and control, whilst at the same time preserving the delicate balance which occurs between man and his external environment. To date, much evidence exists of the international co-operation promoting One Health; examples include reports of joint symposiums between the FAO, OIE and WHO and other associated partners, documents outlining guidelines and frameworks, and the recent inaugural “One Health” congress in Australia. Despite the necessary and commendable actions occurring internationally, a question nevertheless remains on the application of this concept at the local level, particularly in developing countries where risk factors remain high, and resources are arguably fewer. To this end, implementation of One Health approaches for the control of “neglected” zoonotic diseases may be a potential platform whereby developing countries could harness the “One Health” momentum. The sixth Millennium Development Goal, “to combat HIV/AIDS, malaria, and other diseases” arguably strengthens the potential role of a One Health approach in wider poverty alleviation strategies, ensuring sustainable improvements in both human and animal health. Compared to the high profile emerging zoonoses, “neglected” zoonoses such as brucellosis, bovine tuberculosis, porcine cysticercosis and Human African Trypanosomiasis remain endemic throughout many developing countries, with little consideration on their burden and impact. This paper aims to discuss the ways in which programmes for the control of endemic zoonoses could also benefit from the One Health movement and the potential for its contribution to poverty alleviation in developing countries.

Keywords: “One Health”, poverty alleviation, neglected disease, zoonoses

Introduction to One Health:

The Connectivity between Animals, Humans and our Environment

For centuries, the intimate connectivity between animals, humans and the environment, and our inter-dependence upon each other for survival, has been widely noted (Okello et al, unpublished). Examples exist in the literature as far back as the ancient civilizations of Babylon, the Old testament, and in accounts by ancient physicians such as Hippocrates in Greece, and Galen in Rome (Steele, 1964). Rats played a key role in the spread of the bubonic plague that killed millions of people in the Middle Ages, and Rinderpest outbreaks across Europe in the 18th century created serious socioeconomic devastation, so much so that Pope Clement XI requested his personal physician to investigate the disease when it arrived in Italy in 1713 (Steele, 1964).

Numerous historical accounts signifying the relationship between zoonotic disease and human tragedy such as war and famine are also documented. One of the most famous events was the 1861-1866 Glanders epizootic in North America, in which the crowding together of thousands of mules and horses for military purposes during the American Civil War resulted in what became known as the “legacy left by the war” (Sharrer, 1995). The end of the First World War saw “the worst infectious pandemic in history”; the 1918-1919 “Spanish flu” influenza outbreak which killed an estimated 50 million people worldwide. Latest analyses of H1 nucleotide sequences have found close linkages to influenza strains naturally circulating in avian populations at that point in time (Taubenberger *et al* 2005). More recently, restocking of cattle in parts of northern Uganda with a history of civil war and insurgency have contributed to outbreaks of the fatal *T. b. rhodesiense* form of human sleeping sickness (Picozzi *et al*, 2005, Fevre *et al*, 2001).

The term “One Health” has evolved in recent years to illustrate this philosophy of the close relationship between humans, animals and our environment. Synonymous with the term One Health include “One Medicine”, “One World, One Health™” which is a trademark of the Wildlife Conservation Society, or “One World, One Health, One Medicine” as used by the World Veterinary Congress. In 2008, the American Veterinary Medical Association (AMVA) of the United defined One Health as the “collaborative effort of multiple disciplines-working locally, nationally, and globally – to attain optimal health for people, animals and our environment” (AVMA, 2008). Thus, the term “one health” will be used hereafter to refer to the concept of combining multiple disciplines in an effort to prevent and control diseases affecting animals, the ecosystem and the people living within that ecosystem whose livelihoods depend upon them.

Discussion

Early Pioneers of Comparative Medicine

Despite examples throughout history of the close association between infectious disease transmission within and between groups of animals and humans, it was not until the 19th century that formal recognition and responsibility for the control of zoonotic disease first “brought the physician and veterinarian together” (Steele, 1964). At this time, the public health hazards associated with consumption of infected meat and milk were gaining recognition; examples included outbreaks of tuberculosis and scarlet fever, and the scientific confirmation that tapeworm was associated with muscular cysts in the cattle and pigs. The first official recognition of comparative medicine - the “study of the anatomic, physiologic, and pathophysiologic processes across species, including humans” - (Kahn, *et al* 2006b) was recognised in the 19th century when the German physician and pathologist Rudolf Virchow coined the term *zoonosis*, to “indicate the infectious disease links between animal and human health” (Cardiff *et al*, 2008).

Edward Jenner 1749-1823

This English surgeon’s assistant demonstrated that exposure to the zoonotic cowpox lesion helped protect against human smallpox, in what was “arguably the most important observation in the history of infectious disease” (Gibbs, 2005). It is thought that Jenner’s belief in the potential for cowpox to immunise against smallpox stemmed from a comment by a dairy worker in the early years of his apprenticeship that she was, in effect “immune” to smallpox as a result of her contraction of cowpox (McNally, 2001). In 1796 after finding a case of cowpox in a dairy maid he collected matter from the pustules and inoculated it into an 8 year old boy without any side-effects. He later inoculated the boy with smallpox and the fact the disease did not occur led Jenner to undertake a number of studies to convince a rather “skeptical” medical community of his discovery (McNally, 2001). Jenner was ultimately successful; the concept of “vaccination” (named by Louis Pasteur from “vacca” the Latin word for cow) is now familiar to millions worldwide and has helped in the control for a large variety of diseases afflicting human and animal populations to this day (McNally, 2001).

Rudolph Virchow 1821-1902

Rudolph Virchow was a German medical doctor known today by some as the “Founder of Modern Medicine” (Cardiff *et al*, 2008). Virchow’s strong support of the veterinary profession led to the development of veterinary pathology as a recognised discipline. Virchow famously quoted “between animal and human medicine there are no dividing lines – nor should there be. The object is different but the experience obtained constitutes the basis of all medicine” (Saunders, 2000, Kahn *et al*, 2006a). Despite formal training in human medicine Virchow was said to have “respected veterinary research, supported government veterinary training and provided a role model for the veterinarians who were drafting control legislation of contagious diseases in livestock” (Saunders, 2000). It could be said that the modern day systems for public meat inspection in the United States and Europe came about as a result of Virchow’s fascination with the circular structures seen in the muscle of slaughtered pigs; unlike popular belief at the time which considered these structures normal, Virchow determined they were in fact the “curled up larva” of *Trichinella spiralis* (Saunders, 2000). Having proved this theory, Virchow went on to develop a microscopic technique to determine parasitic cysts in raw meat including beef cysticercosis and especially tuberculosis, citing the possible dangers to humans who ate infected cattle with these lesions to the Minister of Veterinary Matters, which in effect signaled the beginning of meat inspection as we know it today (Saunders, 2000).

Calvin Schwabe 1927-2006

The American veterinary epidemiologist, parasitologist and philosopher Calvin Schwabe has been described as the “modern advocate of One Medicine” (Cardiff *et al*, 2008). Schwabe promoted the “One Medicine” concept in his 1984 book *Veterinary Medicine and Human Health*, which strongly echoed the visions that Virchow, Osler and others had promoted a century before him. Schwabe advocated for the human and medical professions to work closely in order to improve human livelihoods through animal disease control, through examples such as hydatids and non-zoonoses such as the effect of Rinderpest on human livelihoods in East Africa (Zinnstag *et al* 2005).

Creation of the Expert Committee on Zoonoses within the World Health Organisation (WHO)

The establishment of the WHO Expert Committee on Zoonoses was largely a result of the work done by “veterinarian, virologist and humanitarian” Martin M. Kaplan, who joined the WHO in 1948 and “single-handedly” developed the Veterinary Public Health programme there (Steele, 2000). During the latter half of the 20th century, the WHO Expert Committee on Zoonoses held a number of joint meetings with the Food and Agriculture Organisation of the United Nations (FAO). Veterinary Public Health was first defined in the 1975 joint FAO/WHO technical report as “a component of public health activities devoted to the application of professional skills, knowledge and resources to the protection and improvement of human health” (FAO 2003). In 1999, a WHO conference was held in conjunction with the FAO and World Organisation for Animal Health (Office International des Epizooties or OIE) in Teramo, Italy. A consensus for the definition of Veterinary Public Health was attained as thus: “*The sum of all contributions to the physical, mental and social well being of humans through an understanding and application of veterinary science*” (FAO, 2003).

One Health in the 21st Century

In just 200 years, the earth’s population has increased by five billion people: from one billion at the beginning of the 19th century, to 6 billion at the year 2000 (Gibbs 2005). It is estimated that earth’s human population will rise a further 2 billion by 2025, largely in developing countries where the majority of the world’s poor live (FAO, 2008). This incessant rise in the number of people on the planet is placing significant strain on the world’s natural resources; the space available for humans and animals to live in harmony with each other and the natural environment is ever decreasing. Increased urbanisation and decreased land availability has meant that farming systems are also changing; in such circumstances the biosecurity measures may become weakened, potentially leading to the threat of emerging new disease and greater potential for viral amplification as a result of intensification (FAO, 2008).

A comprehensive study has revealed that approximately 868 (61%) of the 1416 infectious diseases known to affect humans are of animal origin, with zoonotic diseases overall twice as likely to be associated with emerging infectious diseases compared with non-zoonotic disease (Taylor *et al* 2001). Echoing this, it has been stipulated that up to 75% of the emerging infectious diseases seen in human populations over the last 30 years are of animal origin (Osburn *et al et al* 2009, AMVA 2008).

However despite the obvious concerns surrounding human and animal health in the future, it seems that some experts feel that instead of promoting collaboration, the veterinary and medical communities are moving further apart. In a letter to the editor of the Journal of the American Veterinary Medical Association (JAVMA), Bruce Kaplan writes “the longstanding omission of recognizing and fully utilizing veterinary medicine’s unique and talented biomedical and comparative medicine research potential has been unaccountably short sighted” (Kaplan, 2006). It is perhaps not so much acceptance of the concept, but agreement upon the political and financial aspects of implementation of the one health strategy that requires further refinement; the following examples show how One Health principles have become an important entity in the 21st century.

Avian Influenza – Projecting One Health into the 21st century

Since its discovery in Hong Kong in 1997, the global collaborative response to the H5N1 avian influenza outbreak has arguably revived comparative medicine in the 21st century, and brought the One Health concept to the forefront. The “bird flu” epidemic preceded a stream of international emerging zoonotic disease scares including SARS, Nipah virus and West Nile Virus over recent years, and has prompted calls for closer collaboration between the medical and veterinary disciplines for their control.

USA Monkeypox outbreak 2003: Monkeys and Media in Midwest

In 2003, there were reports of an outbreak of a disease resembling a milder form of smallpox amongst pet owners and handlers in Midwestern United States. The disease was diagnosed as a related poxvirus found throughout west and central Africa known as monkeypox, named after its discovery in monkeys in 1958 (CDC, 2008). Laboratory diagnosis confirmed 71 human cases and resulted in CDC releasing stored smallpox vaccines to vaccinate 30 people against potential occupational exposure (CDC, 2003). The source of the outbreak was established as being a legal shipment of 76 small rodents from Ghana to Texas in early 2003 (Gibbs, 2005). The rodents infected native prairie dogs housed on the premises of one pet distributor, and as a result the virus spread through the distribution of prairie dogs into other states (Gibbs, 2005).

Although the human disease itself was mild with zero mortality, the case caused a furor in national media, raising the alarm of the potential of disease spread from wildlife to humans, and calls for stricter laws in the import and trade of exotic animals. Despite monkeypox being established relatively quickly as the cause, the public was highlighted to how easy it spread in the USA as a result of the “porous nature of the nation’s borders” (Gibbs, 2005).

Nipah Virus Outbreak Malaysia 1998-1999: Pig Deaths in the Burning Forests

Nipah virus, a paramyxovirus with its natural reservoir in fruitbats, first emerged in the Malaysian peninsula in late 1998 (Kaw, 2003). Prior to the first human cases, there had been reports of respiratory illness and neurological disease in pig populations in Malaysia’s Perak state; believed to be Classical Swine Fever. As reports emerged of pig farmers dying from acute febrile encephalitis, serological samples were positive for Japanese Encephalitis (JE) IgM antibodies, encouraging the Malaysian Ministry of Health to put JE control measures in place (Kaw, 2003). The cases continued to build however, including in neighboring Singapore, resulting in swift import bans (Kaw, 2003). Six months after the first human cases in Malaysia, a novel paramyxovirus was isolated and subsequently named Nipah Virus (NiV) (Kaw, 2003).

As one prominent virologist describes, “the Nipah outbreak is a classic example of a One Health type of outbreak involving agricultural practice, migratory bats, domestic pigs, and human disease. The spread of the disease in the country and to Singapore is due to a lack of enforceable quarantine measures, poor agriculture and farming practices and inadequate compensation for culling of domestic animals” (Lam, 2010).

Control of Endemic Zoonoses for Poverty Alleviation

The eight Millenium Development Goals (MDGs) were adopted in 2000; of which the sixth goal “to combat HIV/AIDS, malaria, and *other diseases*” has led to large scale financial interventions aimed to address the issues of infectious disease and their contribution to poverty. However there has been concern that investment in these *other diseases*, otherwise known as the Neglected Tropical Diseases (NTDs), has been “conspicuously ignored” (Molyneux, 2008). Many experts argue that the Disability Adjusted Life Year (DALY) calculation used to prioritise disease is not an applicable tool for many NTDs as “hidden” morbidities such as anaemia, diarrhoea, loss of work and education opportunities associated with neglected tropical diseases are “difficult to ascribe in a disease at the individual level”, and this has an impact on the profile of these diseases (Canning, 2006).

Within the NTDs lie a sub-group of “Neglected Zoonotic Diseases” including Anthrax, Bovine Tuberculosis, Brucellosis, Rabies and Human African Trypanosomiasis (WHO, 2009), which are endemic throughout many developing countries where poverty, reliance on livestock and the proximity within which animals and people co-exist all favour disease spread. Besides affecting the health of people, livestock productivity losses place an additional strain on these communities. Although such conditions also favour the development of emerging zoonotic diseases such as avian influenza and SARS, it is endemic diseases which fall into the category of NTDs and are officially recognised by the WHO as diseases of the poor (WHO, 2009).

The other concern for the lack of global prioritisation for the NTDs, specifically the NZDs, is that often the “burden” is either unknown, or under-estimated. As Maudlin *et al* states, “Many zoonotic diseases are notoriously difficult to diagnose as they are often confused with other diseases; for example, where malaria is present, fevers owing to brucellosis may be misdiagnosed. There may simply be no reliable and cheap diagnostic test available” (Maudlin *et al* 2009). The outcome of this is “serious consequences in terms of funding for both research and control initiatives (of the neglected zoonoses)” (Maudlin *et al* 2009).

The “Integrated Control of Neglected Zoonoses” (ICONZ) seventh framework project is funded by the European Commission and is the first collaborative project of this nature in the field of neglected zoonotic diseases. ICONZ brings together 22 European and African institutions to approach NZD “clusters” in the form of case studies across seven African countries. It is hoped that the understanding of diagnostics, burden of disease and intervention options for NZD control will be much improved as a result of the case studies (ICONZ, 2011).

Stamp Out Sleeping Sickness: A “One Health” Approach for a Neglected Zoonotic Disease

Human African Trypanosomiasis, otherwise known as “sleeping sickness”, is a parasitic disease found throughout 36 sub-Saharan African countries (WHO, 2010). The Rift Valley roughly separates the two forms of the disease; the acute (caused by *Trypanosoma brucei rhodesiense*) found in East Africa, and the chronic form (caused by *Trypanosoma brucei gambiense*) found across parts of West Africa. Uganda is the only country in Africa thought to harbor both forms of disease (Kabasa & Waiswa, 2009). Sleeping sickness is transferred to humans through the bite of an infected tsetse fly (genus *Glossina*), and is classified by the WHO as a “neglected zoonosis” (WHO, 2009); a disease affecting the rural poor where access to health services and diagnosis of these diseases is limited (Butcher 2009).

A long history of research in Uganda had shown the acute *T. b. rhodesiense* form of disease moving out of its endemic areas in the southeast of Uganda into five previously unaffected areas north of Lake Kyoga (Fevre *et al*, 2005). A subsequent survey identified that only 150km separated the acute form from the focus of chronic *gambiense* in the north (Picozzi *et al*, 2005), prompting great concern of a “public health nightmare” which could result if these two forms of disease merged (Butcher, 2009). As a result, the Stamp Out Sleeping Sickness (SOS) initiative was launched in October in 2006 in order to slow the northwards spread of *T. b. rhodesiense* and prevent the merger of the acute and chronic forms. SOS is a public private partnership between the government of Uganda (represented by the Co-Coordinating Office for the Control of Trypanosomiasis in Uganda - COCTU), the French multinational drug company Ceva Sante Animale, IKARE (a UK registered charity), and Makerere and Edinburgh Universities (SOS Press Kit, 2011).

Advancement in molecular diagnostics over the years have found cattle to be the major reservoir of *T.b rhodesiense* (Welburn *et al* 2001); this discovery was a major factor in the SOS intervention design, which included raising awareness and sensitisation of the Ugandan public to HAT, nagana (the cattle form of trypanosomiasis cause by species such as *T. vivax* and *T. congolense*) and the SOS campaign, as well as block treatment of cattle in five districts in an attempt to stave off the northern spread of the acute form (Butcher, 2009). Additionally, five private veterinary practices were established in the northern intervention districts, where communities are encouraged to keep their cattle sprayed against tsetse fly as an ongoing prevention against ticks and nagana, and also human disease (Welburn, SC personal communication). To this end, the SOS campaign is an example of a One Health intervention whereby both political and environmental factors contributed to a changing disease profile, in which treatment of the animal reservoir has ultimately prevented human suffering. The SOS project is now in its second phase, where similar activities are being carried out in Soroti and Tororo districts in the east of Uganda (Okello AL, field observations).

Conclusion

There is undeniable logic for the control of zoonotic disease in developing countries in order to improve human health and subsequent productivity of their livestock, and increase food security and safety. There is also acknowledgement that despite addressing these “neglected” zoonoses of particular concern in certain communities, the capacity for detection of emerging zoonoses will also be increased with community awareness and participation in surveillance networks. Institutional support for the control of neglected zoonoses is growing; several international forums and publications have identified the growing widespread support for their control emulated in this summary “by simultaneously saving lives and securing livelihoods, the control of neglected zoonotic diseases offers a real and highly cost-effective opportunity for alleviating poverty, especially in remote rural communities and marginalized periurban communities” (WHO, 2009).

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Rabies, Animals and Veterinarians in a Globalized Context – New Visions for an Old Disease?

Lea Knopf

*Officer in Charge of the Recognition of Countries' Animal Disease Status
Scientific and Technical, World Organisation for Animal Health (OIE)
12, Rue de Prony, 75017 Paris
France*

Rabies is a neglected and under-reported zoonotic disease killing an estimated 55,000 people each year worldwide, particularly in children. The World Health Organisation recognizes rabies as the infectious disease with the highest case fatality rate and 98% of human deaths resulting from the bite of a rabid dog. Prevention at the animal source is the ultimate key in dealing with a prevalent and perennial zoonosis like rabies. It is the prime responsibility of the veterinary profession to apply its knowledge and skills in animal disease control to creating a buffer between the animal source of the disease and susceptible human beings. The World Veterinary Year, 250 years after the foundation of the first veterinary school in Lyons(France), is an occasion to have a look at the common history of veterinarians and rabies control. The challenges of starting and maintaining successful rabies control programmes are discussed with emphasis on the role of veterinary services, opportunities for improved inter-sectorial and the contributions of OIE to the fight against rabies at the animal source. The OIE provides science-based standards, guidelines and recommendations for the control of the disease in animals and to prevent the spread of the disease through trade as well as standards for the diagnosis of the disease and the preparation of vaccines for use in animals. Through its capacity building programmes, global and regional conferences and its network of reference laboratories and collaborating centres the OIE supports veterinary services with policy advice, strategy design and technical assistance for the diagnosis, control and eradication of rabies.

Keywords: Canine rabies – World Organisation for Animal Health – OIE – veterinary public health – dog population control – vaccination programme – legislation – international animal health and welfare standards

Introduction

The year 2011 is a landmark for the veterinary profession around the world, because in 1761, Claude Bourgelat managed to persuade King Louis XV of France of the need to train specialists to treat animal diseases. By decision of the King, the world's first veterinary school was established in Lyons, France, 250 years ago. Bourgelat pioneered at the same time the concept of comparative pathobiology between humans and animals. He was the first to claim that animal diseases could usefully be studied to gain a better understanding of human diseases.

Today modern veterinarians are not only animal doctors and animal welfare advocates, they are also key public health stakeholders because of their crucial role in: Promoting food security by supervising animal production, monitoring food quality and safety, advancing biomedical research, protecting the environment and biodiversity and controlling zoonoses at the animal source - in line with OIE's overall mandate to improve animal health, veterinary public health and animal welfare world-wide.

Rabies is one of the oldest known diseases occurring primarily in animals and being responsible, still today and on a worldwide scale, for an estimated 55,000 human deaths yearly (Knobel et al. 2005), mainly children bitten by dogs. Dogs are the main source and transmitter of rabies in developing countries which still carry the highest human rabies burden, notably in Africa and in several parts of Asia. Rabies, the most fatal infectious disease in the world, is essentially a public health problem, with little or moderate effects on animal production, resulting in reluctance or inability of governments to mobilise resources to fight rabies, be it at the animal source or in humans (Rupprecht et al. 2008). The general lack of interest has resulted in severe underreporting of rabies cases in animals and in humans and risks to further decrease the attention which rabies should receive from the international community including donors. It has been argued that control of rabies at the animal source is much cheaper and more sustainable in mid- and long-terms than prophylactic treatment of rabies-exposed humans (Bögel & Meslin 1990, Zinsstag et al. 2007). Controlling rabies in dogs, including stray dogs, should therefore be the highest priority in preventing human deaths, worldwide. This paper provides historical examples and insights into the

crucial role of the veterinary profession and the OIE in animal rabies control and prevention of human rabies cases worldwide.

Materials & Methods and Results

Historical aspects of rabies control

The importance of rabies in different societies around the world and across millenaries is highlighted by documented historical regulations against rabies or dealing with control measures targeted to rabid dogs, because all civilisations observed that rabies was inexorably fatal.

The disease of 'mad dogs' was already described in EshunnaLaws in Mesopotamia, as early as in the 18th Century BC (Théodoridès 1986). These laws provided for fines to be paid by owners of dogs biting a man in case the bite was leading to death of that person. Clinical signs of rabies continued to be described in detail over centuries in historical documents originating from various parts of the world (Blancou 2003). Unlike other animal diseases, there was apparently no controversy over the contagiousness of rabies or dogs being a major source of livestock and human infection, even in the most distant past when the biology of infectious agents was not yet understood. Despite the long incubation period of rabies, the transmission of the disease via dog bites or rabid dog's saliva was recognised. Before the first successful use of rabies vaccine to a human exposed to a rabid dog in the late 19th Century, confinement and killing of rabid animals and bite wound treatment (in humans and animals) were the only preventive methods available. Therefore attempts to promote responsible dog ownership, complete banning of dogs from certain areas or systematic killing or preventive confinement of rabies suspect dogs or stray dogs were prescribed by law and practiced in various regions of the world. In particular the control of biting dogs, be it by means of chaining, leashing or muzzling, was recommended throughout ancient Greece and Rome and in religious texts e.g. the Talmud or the *Avesta* of the 7th Century BC from Persia (Théodoridès 1986). Compulsory reporting of rabid dogs to the local authority, quarantine measures and compulsory dog registration are documented only from the 18th and 19th Centuries onwards, mainly in Europe. When rabies vaccines became widely available in the early 20th Century, unfortunately these were exclusively used to treat rabies exposed people and not to fight the halt infection in the animal source.

Notwithstanding the historically recognised importance of controlling this public health problem most effectively at the animal source, international concerted action of veterinarians or national veterinary services to the goal of eliminating human rabies at the animal source started only later: During the second General Session of the then 'Office International des Epizooties' (OIE) in 1928 the representatives of veterinary services around the globe adopted a resolution (Anonymous 1928) dedicated to rabies. These strong recommendations called for a better commitment of governments for rabies control, including collaboration with the public health sector and international harmonisation in rabies control and eradication at the animal source. This set of recommendations included guiding principles such as helpful cross-border collaboration in rabies elimination, the duty of veterinarians towards public health impact of rabies, compulsory registration of owned dogs, prophylactic killing or confinement of rabid and suspect animals respectively, conditions for using rabies vaccine in animals, the vaccine quality and countries' annual reporting to the OIE on the epidemiological rabies situation. Many aspects of these guiding principles are still considered valid pillars of today's strategies. Sadly, the first paragraph of the cited OIE resolution, the outcry for a more active commitment of all governments in rabies control, is of continuous actuality.

Challenges of rabies control today

The current scale of movements of animals and people every day is unprecedented in human history. Pathogens may likewise be carried around the globe, with the result that international travel and trade have become critical factors in disease dissemination. In the case of commercial and non-commercial movements of dogs, cats or other rabies susceptible species worldwide, border inspections and veterinarians face increasing legal and illegal movements both representing a non-negligible risk, particularly the latter, of re-introduction of rabies to areas or regions where rabies was controlled successfully.

Some countries have implemented vigilant control measures and succeeded in eradicating rabies, e.g. North America or Western Europe. Among the animal health reports submitted by 181 countries or territories to the OIE and available in 2010, 114 stated that rabies was present in their territory¹. The 26 countries which self-declared that rabies has never been present in their territory are mainly small islands located in the Asia-Pacific and partly the Caribbean region. Another 41 territories or countries self-declared that they had no rabies outbreaks at least since their previous annual animal health report (in some of these countries the last rabies outbreak occurred several decades ago). Many rabies affected countries in Africa

and Asia base their statements solely on clinical observations and there is a lack of laboratory based surveillance to confirm rabies cases and to describe the reality in the field (geographical location, numbers, species affected), leading to significant underreporting of both human and animal cases of this fatal disease. Although improvements have been observed over the past years, there are currently only 158 out of 178 OIE Member countries where rabies is listed as a notifiable disease in their veterinary and public health legislation (Figure 1). However, 8 OIE Members report that rabies is not a notifiable disease in their country and an additional 13 did not provide any information on rabies notification during the last three years.

Starting and sustaining a successful rabies control programme pose challenges also at the institutional level and far too often responsible agencies of countries resign for several reasons: a) Sustainable rabies control relies on formal establishment of information exchange between and collaboration with all sectors involved, i.e. good inter-sectorial coordination; b) the public health impact of rabies calls for budget allocation across ministries usually difficult to negotiate; c) rabies elimination campaigns have to be implemented thoroughly over several years to be successful; d) the institutional leadership in rabies control is characterised by an enormous variety from region to region or even within countries, there is no suitable model 'best for all'; and e) most resource-limited countries expect their veterinary services to prioritize livestock health, thereby excluding dogs. Unfortunately these institutional inadequacies cited above had led to shortcomings in rabies control over decades. Moreover, comprehensive rabies control programmes do need long term political commitment extending into decades and in consequence considerable resource mobilisation in different ministries. The veterinary services and other supporting institutions at national and local levels still exert themselves with the responsibility of delivering a service that would be compatible with, and in support of, the generally accepted concept that effective control of zoonotic diseases (such as rabies) is most cost efficient and best done at the animal source (Zinsstag et al. 2009). Examples showed that collaboration between ministries (e.g. public health, animal health, environment, wildlife and education) and agencies (over different administrative levels including municipalities) is a core component of a successful strategy to effectively control rabies and also other zoonoses (Zinsstag et al. 2007).

Overall, good governance of veterinary services, better laboratory diagnosis capacity and vaccination campaigns in domesticated and wild animals were identified as key actions to be taken. Emphasis must also be put on raising public awareness of rabies and on the need for collaboration with other professions involved, namely the public health sector.

OIE's activities on rabies and its support to OIE Members today

Since its foundation in 1924, one of the main objectives the OIE has pursued is to ensure transparency in the global animal disease situation. OIE Members are encouraged to include OIE listed diseases, such as rabies, within their national legislation as compulsorily notifiable diseases (Anonymous 2010) to facilitate notification of outbreaks (in domestic animals, humans and wildlife) and thereby improve knowledge on their epidemiology – a crucial basis for launching any relevant

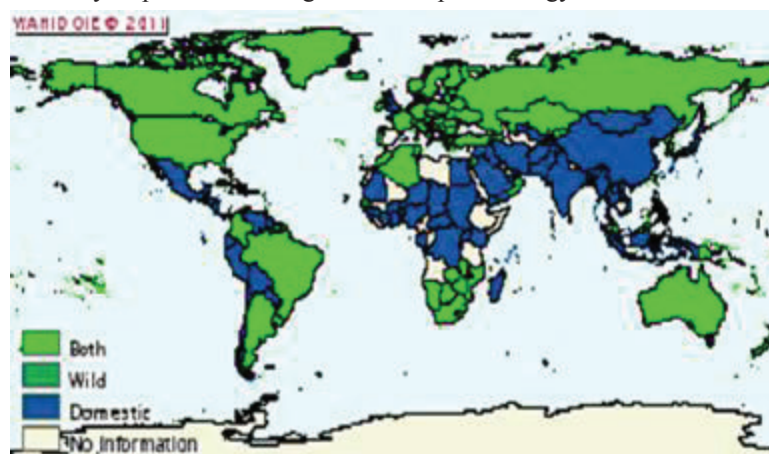


Figure 1: Overview map on countries which included rabies into their legislation as a notifiable disease (data WAHID 2008-2011). A differentiation between compulsory notification in domestic animals, wildlife or both is shown

¹ Source: Latest six-monthly report available, World Animal Health Information Database WAHID, <http://web.oie.int/wahis/public.php?page=home> accessed 5 April 2011

disease control programme.

The OIE is the international standard setting organisation for animal health and welfare. OIE standards are democratically adopted by all OIE Members. For terrestrial animals the OIE's disease control policy is expressed in the 'Terrestrial Animal Health Code' and the 'Manual of Diagnostic Tests and Vaccines for Terrestrial Animals' which are based on latest science available. These OIE standards promote the use of internationally standardized, accepted definitions and concepts. Implementation of these concepts for disease control programmes promote harmonization and equivalence between countries' national legislations and support safe international trade, e.g. systematic import risk analysis to prevent introduction of disease. OIE standards promote protection of human health through the control of animal diseases including zoonoses, given that the contribution of healthy animals to food security is as essential to human health as protection of humans from zoonoses. Furthermore, the Terrestrial Animal Health Code of the OIE includes animal welfare provisions based on ethical principles to be applied in trade and animal disease control. Application of standards for diagnostic techniques and vaccines that meet OIE and/or WHO criteria, as well as surveillance activities are considered key components of any disease control programme. OIE reference laboratories and WHO collaborating centres work together for international harmonisation of laboratory methods for the diagnosis and the quality control of vaccines. Additionally since 2008, the OIE twinning between laboratories (Anonymous, 2010) and training programmes have been intensified to improve diagnostic capability in animal health laboratories throughout the world.

The OIE Terrestrial Animal Health Code chapter on rabies is currently under revision to offer better guidance for a stepwise control of the disease, focusing on the epidemiologically most relevant host species (dogs, cats and ferrets) and rabies virus (not on bat lyssaviruses). As an intermediate step, on the way towards rabies elimination and freedom in all species, a new category of 'country free from dog-to-dog transmitted rabies' has been introduced into the draft texts. This intermediate step in achieving freedom from rabies will support progressive improvement in transparency in notification and increased engagement of countries in rabies control programmes. Also the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals is under revision to account for up to date guidance on newly available rabies vaccines for animals, both for oral and parenteral use.

Although immunization of animals against rabies, in particular rabies reservoir species, has proven to be the method of choice for controlling or eliminating rabies successfully (Lembo et al. 2010; Beyer HL et al. 2010), there are a number of important accompanying measures described in the OIE Terrestrial Animal Health Code that are necessary to achieve sustainable rabies control or elimination:

- Dog population monitoring and control, including stray dogs (using OIE standards published in the Terrestrial Animal Health Code)
- pre- and post-vaccination monitoring of target population (in particular when heading towards rabies eradication),
- awareness campaigns targeting dog owners, children and greater public, through the exchange of information, experience and cooperation between medical, veterinary, environmental and local authorities,
- prevention of rabies introduction (border control measures, better monitoring and control of animal movements),
- harmonisation of strategies and control measures between ministries and between neighbouring countries (particularly in the control of rabies in wild or feral animals), and
- wildlife management (if applicable and relevant to the local rabies epidemiology).

The OIE was created by and relies on the veterinary services in the entire world. In consequence it has built on strategic strengthening of veterinary services from the beginning by advocating harmonised implementation of core duties of veterinary services to protect human and animal health. Since 2007 OIE Members have the opportunity to ask for an independent assessment of their veterinary services to verify whether they meet the quality requirements and, where appropriate, to organise the progressive improvement of the quality of the services they provide, using the PVS-Tool for evaluation of performance of veterinary services. By end of March, 101 (out of 113 requests) PVS evaluation missions by OIE-trained experts have been

completed. They are usually followed by identification and analysis of existing gaps to enable the appropriate investments to be made rapidly (Gap Analysis). Thirty-six out of 67 requests for Gap Analysis missions were completed by 12 April 2011.

Additionally the OIE launched a network and training programme for topic-specific national focal points designated by and assisting the OIE Delegate in fulfilling his duties towards the OIE and the international community. In each OIE of the 178 Members there are now 6 specialised national focal points who regularly receive trainings in their corresponding topic. The national focal points, for example those for wildlife and for animal disease notification, have the potential to significantly enhance implementation of cross-sectorial collaboration and information exchange in the control of rabies and other diseases.

In summary OIE activities aim at providing technical tools and political support to improve the countries' good veterinary governance, because an effective animal disease and zoonosis control policy is directly related to the ability and capacity of a country to apply the policy.

Discussion

Veterinary services are professionally speaking in a key position to eliminate human zoonosis infections via control of disease at the animal source. Rabies control in the animal sector saves money and provides the economic argument, which may open new approaches for zoonosis control in resource-limited countries through contributions from multiple sectors (Bögel & Meslin 1990, Zinsstag et al. 2007). Taking into account also the total societal benefits the veterinary services' activities should be supported by appropriate budget allocation across sectors and administrative levels e.g. from the ministries of health or from the general budget of municipalities. The animal vaccination approach will lower the high cost of post-exposure prophylaxis in humans over time and benefit the population in remote areas where the availability of prophylactic treatment is limited (Lebo et al. 2010). However, systematic vaccination of reservoir species requires careful planning and regular review in consultation with experts and the stakeholders involved and should be started only when the target animal population is identified, the local rabies epidemiology is understood, sustainable delivery of high quality vaccine can be assured, surveillance and post-vaccination monitoring are in place and accompanying measures as described above do complement the vaccination campaign.

Combining other disease control interventions with activities of rabies control programmes, including dog population control, programme revisions at regular intervals of progress and publicising of programmes to the greater public improve their impact and may create incentives for a variety of stakeholders. For these reasons a consistent rabies control strategy must be prepared by taking on board relevant stakeholders across sectors and administrative levels, e.g. public and animal health services, environmental and/or wildlife agencies, police, customs, local authorities including municipalities, NGOs and the general public. The international organisations - WHO, OIE and FAO - continue to jointly elaborate general or disease-specific guidelines in line with the concepts of the "The FAO-OIE-WHO Collaboration Tripartite Concept Note - Sharing responsibilities and coordinating global activities to address health risks at the animal-human-ecosystems interfaces, which underscores the importance of inter-sectorial collaboration. PVS Evaluations and PVS Gap Analyses may be used in negotiations between the Ministry of Agriculture, Ministry of Finance, and donors to provide detailed estimates of the cost of achieving compliance with international standards.

The rabies control programme components and principles as outlined above were confirmed by the two international conferences on rabies organised by OIE in collaboration with WHO, EU and other partners: 'Rabies in Europe' (Kiev (Ukraine), 15-18 June 2005) and 'Towards the Elimination of Rabies in Eurasia' (Paris, OIE 27-30 May 2007). A third world-wide conference on rabies, is being organised by OIE and will be held in Seoul, Republic of Korea, 7 - 9 September 2011. This forthcoming conference will tackle problems of implementation and institutional changes needed to succeed in sustainable rabies control at the animal source.

Substantial progress in rabies control is dependent on a better involvement of veterinary services and their partners in dog-mediated rabies, through institutional changes and awareness campaigns, both on national and regional level. The preliminary results of the major endeavour of re-assessing the global rabies burden will become available by the end of 2011, more accurate figures reflecting the worldwide rabies situation are expected. These figures could be used to increase the awareness of governments and donors that rabies control and eradication merits more attention than is the case today. OIE and

some its partners² may develop more detailed guidelines on rabies control, with a focus on institutional and legal frameworks of veterinary services, taking advantage of experience gained in the various successful regional control programmes.

The selected theme of the World Veterinary Day of 2011 - 30 April - is raising awareness of veterinarians' role in rabies prevention and control. The World Veterinary Year and the World Veterinary Day 2011 are a most welcome opportunity to sensitize on one hand the public on the severity of the rabies situation in the world and on the other hand to remind the veterinarians about their duty to actively get involved in rabies control at the animal source. These activities will receive an additional platform, the 'OIE global conference on rabies control, towards sustainable prevention at the source' in September 2011 (Seoul, Republic of Korea), because canine rabies elimination is feasible!

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OIE International Animal Welfare Standard Setting Role: Past, Present and Future

David Bayvel

*OIE Working Group on Animal Welfare
MAF Biosecurity New Zealand (MAFBNZ)
Box 2526 Wellington
New Zealand*

The World Organisation for Animal Welfare (OIE) has indirectly contributed to animal welfare, since its establishment in 1924, via its global contribution to improved animal health. The OIE's specific, and overt, involvement in animal welfare is, however, relatively recent. In formulating the third OIE strategic plan, for the period 2001 – 2005, animal welfare (along with animal production food safety) was identified as an emerging domestic and international strategic issue for OIE members in all five Regions.

This paper describes, and discusses, key achievements, to date, including the following:

- Establishment of the OIE Animal Welfare Working Group
- Development and adoption of nine OIE standards by nine *ad hoc* groups
- Successful global conferences held in Paris (2004) and Cairo (2008)
- Inclusion of animal welfare content in OIE website and OIE Bulletin
- Specific animal welfare publications in OIE Scientific and Technical Review Series and OIE Technical Series
- Recognition of Animal Welfare Collaborating Centres in Italy, Chile/Uruguay and NZ/Australia
- In principle support for the proposed Universal Declaration on Animal Welfare (UDAW)

Current priorities will be discussed, including the following:

- Development of production animal standards
- The role of private standards in animal welfare
- Issues relating to international air transport of research animals
- The relationship between animal welfare and food safety
- Development and implementation of Regional Animal Welfare Strategies
- Inclusion of animal welfare in the Performance of Veterinary Services (PVS) tool
- Support for animal welfare initiatives via the Global Animal Health and Welfare Fund
- Planning for a third Global Conference on Animal Welfare to be held in the Asia, the Far East and Oceania Region in January, 2013
- Animal welfare and disaster management
- Wildlife animal welfare issues

Animal welfare has continued to receive emphasis in the fourth and fifth OIE strategic plans. The subject can now be considered as “core” OIE business, with animal welfare explicitly included in the OIE's global mandate “to improve animal health, veterinary public health and animal welfare worldwide”.

The paper concludes by discussing some key challenges likely to be faced by the OIE in the years ahead.

Keywords: OIE, animal welfare, international standards, animal welfare achievements, animal welfare challenges.

Introduction

Over the last 50 years, there have been dramatic increases in agricultural productivity, due to general advances in agricultural and veterinary science, specific improvements in genetics, nutrition and disease control and prophylaxis, plus the impact of agriculture support programmes. There has also been an inexorable and substantial move to more intensive systems of production, especially in the more densely populated nations of Europe, Asia and North America and particularly with pigs, poultry and beef cattle. More extensive systems of production continue to be practised in New Zealand, Australia, South America and Africa, for grazing species, and there is a strong public perception that more extensive management systems are synonymous with better welfare.

Seminal texts by authors including Harrison, Singer, Regan, Rollin, Webster, et al, plus the UK Brambell report (cited in Appleby and Hughes, 1997), the concept of the “five freedoms” and the influence of behavioural science, have all had a significant impact, particularly in Europe and North America, on the attitudes to animal welfare of scientists, the public at large and, through them, politicians. Welfare aspects of animal agriculture, and associated consumer preference behaviour, have also attracted increasing attention from some agricultural economists (McInerney 1998, Harper 1998) and agricultural ethicists.

In their paper “Animal Welfare and Product Quality”, Jago et al (2000) emphasised the importance of science-based animal welfare standards and the value of the five freedoms by stating,

“Most concepts of animal welfare include avoidance of undue suffering, optimising animal health and vigour and are aimed at achieving practices and environmental conditions which are fair and reasonable for the animal. Although the concept of animal welfare is widely regarded as being important, currently there is no single definition of animal welfare that has met with universal approval. People’s beliefs and understanding of what is meant by “welfare” and what is optimal or sub optimal welfare will vary, depending on such factors as their cultural, scientific, religious and political backgrounds.”

According to Kellert (1988), the attitudes people have towards animals can be classified into nine categories including naturalistic, ecologicistic, humanistic, moralistic, scientific, aesthetic, utilitarian, dominionistic and negative and that differences exist between countries in the predominant attitude. Despite these differing attitudes towards animals, there is a biological basis for evaluating animal health and welfare, and widespread acceptance that decisions about animal welfare should be based on good scientific evidence.

The Council of Europe has played a key role in developing standards for Europe and which are taken note of internationally. These standards are based on both scientific evidence and practical experience and also emphasize the importance of the relationship between animal health and animal welfare.

It is helpful to have basic guidelines or rules to refer to when making decisions that may impact on an animal’s welfare. Probably the most widely utilised set of guidelines is the ‘five freedoms’ (Farm Animal Welfare Council 1993). These state that for an animal’s welfare not to be compromised it must have: freedom from thirst, hunger and malnutrition; freedom from discomfort; freedom from pain, injury and disease; freedom to express normal behaviour; and, finally, freedom from fear and distress. Sometimes slight modifications are made to these basic freedoms (e.g. fear is sometimes omitted from the final freedom), however, they generally serve as a set of goals towards which animal owners and handlers should strive. The five freedoms have been used by many legislators and frequently appear as the basis upon which animal welfare codes and practices have been established.

As guidelines, the five freedoms provide a most useful paradigm. They should, however, not be taken as absolute requirements and increasingly, they are seen to have important limitations by forward-looking animal welfare science thinkers (Broom and Mellor Pers. Comm. 2003).

There is an unfortunate tendency to underestimate the importance of animal health in relation to animal welfare. The prevention and control of disease in all species makes a major contribution to animal welfare and veterinarians, in general,

and the OIE, in particular, play a vital role in this regard.

Adams (2001), in reviewing the publication “Livestock in 2020: The New Food Revolution” (Delgado, 1999) emphasises the opportunity for veterinarians “to act locally but think globally” about animal welfare. This joint publication of the International Food Policy Research Institute in Washington, the Food and Agriculture of the United Nations (FAO) and the International Livestock Research Institute in Nairobi provides detailed information on the dramatic increase in the world’s consumption of food, derived from animals, over the last 30 years.

Expanding human populations, urbanisation and income growth are expected to continue, and even accelerate, the trend and Adams (2001) asks “is it time to rejuvenate the science of animal husbandry to ensure that animals are better protected?” The importance of knowledgeable and caring animal husbandry is recognized as an essential prerequisite to maximising animal welfare (Hemsworth, 1993).

Fraser (1999, 2001) has emphasised the importance of the linkage between animal ethics and animal welfare and the vital relationship in terms of public and societal opinion, between historical cultural attitudes to animals and their use in modern agricultural systems. He argues that there is an urgent need to create a new consensus regarding the use of animals in agriculture. The veterinary profession, at large, and the OIE in particular, are well positioned to make an important contribution to this debate.

Bovine Spongiform Encephalopathy (BSE) and outbreaks of Classical Swine Fever (CSF) and Foot and Mouth Disease (FMD) in Europe, over the last decade, have led to the slaughter of millions of animals and intense political and professional debate on the ethics and scientific basis of certain production systems.

Role of OIE

Since its establishment in 1924, the three principal aims of the OIE have been:

- The provision of information on infectious animal diseases worldwide;
- International promotion and co-ordination of studies on the surveillance and control of infectious diseases of animals;
- The harmonisation of international agreements and regulations for disease control including the facilitation of trade in animals and animal products.

The OIE has historically made a major indirect contribution to animal welfare globally, via the organisation’s involvement in epizootic disease control and has included a chapter in the animal health code on minimum animal welfare standards for trade. It has also played a standard setting role in respect of animal transportation and, in 1994, published “Animal Welfare and Veterinary Services” in the Scientific and Technical Review Series (Moss 1994). This publication provided a valuable overview of the animal welfare role played by Government Veterinary Departments in OIE member countries and included review articles on specific international animal welfare issues. The work of the organisation assumed a new prominence, in the 1990s, through recognition of its role in providing standards, guidelines and recommendations for animal health and zoonoses through the SPS agreement of the WTO.

In recognition of the increasing scientific, political and public attention given to animal welfare, in general, and its role in international trade, in particular, animal welfare was identified as an important emerging issue during the preparation of the 2001 – 2005 OIE third strategic plan. At the 69th session of the OIE International Committee, approval was given to the Director General’s work programme to implement the recommendations of the strategic plan. In this programme, it was agreed to establish a new department specifically responsible for international trade in animals and animal products which would provide extra resources to address new topics including food safety, zoonoses and animal welfare. It was agreed that initial scoping documents would be commissioned to assist in defining the degree and scope of OIE involvement with these new topics.

The 70th General Session of the OIE was held in Paris during May 2002. The Director-General, Dr Bernard Vallat,

presented specific recommendations concerning the scope, priorities and modus operandi for the OIE's involvement in animal welfare (Anon 2002) and these were fully endorsed by the then 164 member countries. These recommendations were based on the work of an *ad hoc* group of international experts and included the following:

- The OIE should develop a detailed vision and strategy to recognise the complex nature of animal welfare issues.
- The OIE should then develop policies and guiding principles to provide a sound foundation from which to elaborate specific recommendations and standards.
- The OIE should establish a working group on animal welfare to coordinate and manage animal welfare activities and the working group should advise on specific tasks to be carried out by ad hoc groups.
- In consultation with the OIE, the working group should develop a detailed operational plan for the initial 12 months, addressing the priority issues identified.
- The working group and its ad hoc groups should consult with non-government organisations (NGOs) having a broad international representation and make use of all available expertise and resources, including those from academia, the research community, industry and other relevant stakeholders.
- The scope of OIE involvement in animal welfare issues should be grouped into the following:
 - § Animals used in agriculture and aquaculture for production, breeding and/or working purposes
 - § Companion animals including exotic (wild-caught and non-traditional) species
 - § Animals used for research, testing and/or teaching purposes
 - § Free-living wildlife, including the issues of their slaughter and trapping
 - § Animals used for sport, recreation and entertainment, including in circuses and zoos, and that, for each group, in addition to essential animal health considerations, the topics of housing, management, transportation and killing (including humane slaughter, euthanasia and killing for disease control) be addressed.
- The OIE should give priority to animal welfare issues regarding animals used in agriculture and aquaculture and, regarding the other groups identified, the OIE should establish relative priorities to be dealt with as resources permit.
- Within the agriculture and aquaculture group, the OIE should firstly address transportation, humane slaughter, and killing for disease control, and, later, housing and management. The OIE should also consider animal welfare aspects, as issues arise, in the areas of genetic modification and cloning, genetic selection for production and fashion, and veterinary practices.
- When addressing zoonoses, the OIE should give priority to addressing the animal welfare aspects of animal population reduction and control policies (including stray dogs and cats).
- The OIE should incorporate within its communication strategy key animal welfare stakeholders, including industry and NGOs.
- The OIE should incorporate animal welfare considerations within its major functions and assume the following specific roles and functions:
 - § Development of standards and guidelines leading to good animal welfare practice;
 - § Provision of expert advice on specific animal welfare issues to OIE stakeholder groups, including member countries, other international organisations, industry and consumers;
 - § Maintenance of international databases on animal welfare information, including different national legislation and policies, internationally recognised animal welfare experts, and relevant examples of good animal welfare practice;
 - § Identification of the essential elements of an effective national infrastructure for animal welfare including

- legislation/legal tools and the development of a self-assessment checklist;
- § Preparation and circulation of educational material to enhance awareness among OIE stakeholders;
 - § Promotion of the inclusion of animal welfare in under-graduate and post-graduate university curricula;
 - § Identification of animal welfare research needs and encouragement of collaboration among centres of research.

Work Programmes

The working group developed a work programme for 2003, which addressed the following issues:

- Statements of mission, guiding principles and policies for adoption by the International Committee in 2003
- Development of expertise and stakeholder databases
- Animal welfare conference scheduled for February 2004
- Terms of reference, scope and membership of ad hoc groups, with possible meetings of two ad hoc groups in the first half of 2003
- Increasing awareness of animal welfare in undergraduate training
- Increasing awareness of animal welfare research needs and funding requirements
- Promoting collaboration among academic and research institutions
- Communications plan addressing both internal and external audiences
- Identification of future activities and emerging issues (e.g. animal biotechnology and aquaculture).

The working group reviewed the scope, drafted terms of reference, and identified potential members for four separate groups covering land transport, sea transport, humane slaughter (including a subgroup for religious slaughter) and killing for disease control. The working group also recommended that OIE continue to work with the International Air Transport Association (IATA) and the Animal Transport Association (ATA) on transport issues.

The following draft mission statement, guiding principles and policies were prepared:

Guiding Principles for Animal Welfare

The draft mission is:

To provide international leadership in animal welfare through the development of science-based standards and guidelines, the provision of expert advice and the promotion of relevant education and research.

The OIE will achieve this mission through:

- Promotion of science-based understanding of animal welfare
- Utilisation of appropriate expertise
- Consultation with all relevant stakeholders
- Recognition of regional and cultural dimensions
- Liaison with academic and research institutions
- Use of communication tools appropriate to all relevant audiences

The draft guiding principles are:

- That there is a critical relationship between animal health and animal welfare
- That the internationally recognised ‘five freedoms’ provide valuable guidance in animal welfare
- That the internationally recognised ‘three Rs’ (reduction in numbers of animals, refinement of experimental methods and replacement of animals with non-animal techniques) provide valuable guidance for the use of animals in science
- That the scientific assessment of animal welfare involves diverse elements which need to be considered together, and that selecting and weighing these elements often involves value-based assumptions which should be made as explicit as possible
- That the use of animals in agriculture and science, and for companionship, recreation and entertainment, makes a major contribution to the well-being of people
- That the use of animals carries with it a duty to ensure the welfare of such animals to the greatest extent practicable
- That improvements in farm animal welfare can often improve productivity and hence lead to economic benefits
- That equivalent outcomes (performance criteria), rather than identical systems (design criteria), be the basis for comparison of animal welfare standards and guidelines

Policies

In undertaking its animal welfare role, the OIE seeks to adhere to the following policies:

- That it will make appropriate use of international scientific expertise in the development of animal welfare guidelines and standards
- That, in addition to the use of established consultation processes, the OIE will consult with NGO and industry stakeholder interests, which can demonstrate a broad-based international approach to issues
- That it will encourage the teaching of animal welfare and animal ethics in veterinary and other undergraduate curricula around the world
- That it will encourage the identification of animal welfare research needs and the provision of public and private sector funds to address these needs
- That it will encourage science-based methods to assess animal welfare outcomes
- That OIE’s initial priorities for animal welfare will be animals in agriculture and aquaculture particularly relating to transport, humane slaughter, and humane killing for disease control purposes
- That it will take into account regional and cultural dimensions
- That it will use communication tools appropriate to audiences

In pursuing this important initiative, particular attention is being given to the following specific points:

- The important OIE international leadership role
- That the OIE is aware of the importance of involvement of a broad range of stakeholders
- That the OIE recognises the need to ensure standards are relevant to all Member Countries
- The widespread support from international industry groups, NGOs and international science organisations
- The major scientific and communications challenge which this initiative presents
- That adequate re-sourcing is essential to maintain initial momentum and ensure early achievements

- That the OIE sees future standards contributing to improved animal welfare internationally and valuable for bilateral agreements

Updated work plans have been prepared for each subsequent year and are presented annually to the General Session for endorsement.

The 2005 General Session also supported the commencement of work in the following new areas:

- Aquatic animal welfare
- Laboratory animal welfare
- Wildlife welfare
- Stray dog control
- Production animal housing

The following four sets of guidelines were adopted unanimously at the 2005 General Session:

- Guidelines for the transport of animals by sea
- Guidelines for the transport of animals by land
- Guidelines for the slaughter of animals for human consumption
- Guidelines for the killing of animals for disease control purposes

(Guidelines for the transport of animals by air had already been included in the Terrestrial Animal Health Code).

Additional guidelines adopted since 2005 include the following:

- The control of stray dog populations
- The transport of farmed fish
- The slaughter of farmed fish
- The use of animals in research and education

Animal welfare has also received ongoing emphasis in both the OIE fourth strategic plan for the period 2006-2010 and the fifth strategic plan for the period 2011-2015.

Discussion

Animal welfare is a complex, multi-faceted public policy issue which includes important scientific, ethical, economic, religious, cultural and political dimensions. There is a real concern, in some quarters, that its recognition as an international trade policy issue is sought for “trade protectionism”, rather than “animal protection” reasons. A strategic approach underpinned by science-based policy and standards and an incremental approach to animal welfare change management (Mellor and Stafford, 2001) helps, however, to directly address such concerns.

The need for international leadership in respect of animal welfare policy and standards is likely to be an expanding core role for the OIE in the decades ahead. International scientific and professional organisations such as the International Society for Applied Ethology (ISAE), the World Veterinary Association (WVA), the International Council for Laboratory Animal Science (ICLAS), and the International Association of Colleges of Laboratory Animal Medicine (IACLAM) work closely with the OIE, as do international industry and animal welfare advocacy organisations. Other organisations such as the FAO and World Bank have also taken an active interest in animal welfare and in March, 2003, the Government of the Philippines hosted an inter-governmental meeting attended by 25 countries to discuss the possible development of a Universal Declaration

on Animal Welfare. The EU has also emphasised its strategic commitment in this area through the Welfare Quality Project and the Five Year Action Plan for the period of 2005 - 2010. Both these initiatives will continue beyond 2010.

There is also, a significant increase in interest in animal welfare at University undergraduate and postgraduate level and the establishment of Animal Welfare Chairs in Universities in Canada, the USA, the EU and New Zealand and Australia, over the last few decades, has provided academic and research direction to this interest. Progress in the area of animal welfare will, of course, be a case of “evolution not revolution” based on the principle of incremental change management (10). It is vitally important that all such changes be science-based and validated, be implemented over realistic time frames and take account of economic and cultural factors.

Implementation of the agreed OIE strategic initiative on animal welfare presents significant challenges to ensure identification of priorities, an appropriate focus and effective use of resources. The approach adopted must recognise the intense interest of non-governmental organisations, the public and politicians and the significant scientific contribution, which can be made by non-veterinarians. In its third strategic plan the OIE gave increased priority, and allocated additional resources, to increasing its public profile and communication effectiveness. This initiative is particularly relevant to any future enhanced animal welfare role, as all forms of media take an active, ongoing interest in animal welfare issues. In addition to full ownership of, and “buy-in” to, OIE’s animal welfare role by its 178 members, it is considered strategically and politically important that other stakeholder groups, including industry groups, NGOs and the WTO, are also fully supportive of this role. The major international conferences held in 2004 and 2008, thus, included all stakeholder groups.

Conclusion

The progress made by the OIE, to date, in relation to international animal welfare leadership is, by any standards, impressive. The future OIE *modus operandi* will be characterised by a commitment to communication, consultation, continuous improvement and incremental change, as part of a long-term ‘journey’, rather than any expectation of reaching a short to medium-term ‘destination’.

The notion of approaching animal welfare change management on a truly global, rather than a regional, basis represents a significant paradigm shift. The support goodwill and *esprit de corps* so evident during the initial 2004 conference established a firm platform for future cooperation and collaboration.

Regional animal welfare strategies are being developed within the five OIE regions and a second successful global conference was held in Cairo, Egypt in October 2008. This conference was clearly focused on supporting the implementation of the OIE standards.

Implementation of OIE standards will also be supported by the recognition of OIE Animal Welfare Collaborating Centres in Italy, Chile/Uruguay and New Zealand/Australia. Animal welfare education has been identified as an important core element of the veterinary undergraduate and postgraduate teaching curricula at international conferences hosted by both the OIE and the AVMA/AAVMC during 2009. A second OIE Global Conference on Veterinary Education will be held in Lyon in May 2011 and will include a report from an *ad hoc* group which is approaching this issue from a truly global perspective. Important American animal welfare education initiatives are also being coordinated by the AVMA.

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The important roles played by the OIE Animal Welfare Working Group, the various OIE *ad hoc* groups established to date, OIE Headquarters, OIE Regional Commissions and Representations, and the commitment of the international NGO movement and international industry, scientific and professional organisations, to work closely with the OIE in advancing animal welfare worldwide, is gratefully acknowledged, as is the invaluable administrative support provided by Ms. Brigid Jenkins in the preparation of this paper.

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Welfare of Working Animals

Karen Reed

Head of Animal Welfare and Research

The Brooke

30 Farringdon Street, London EC4A 4HH

United Kingdom

This paper will provide a global overview and look at the complexities of the welfare challenges affecting transport and traction animals with a focus on working equids and the link between the welfare of humans and the animals on which they depend.

As many as 300 million people are dependent on working equids for their livelihoods, but often lacking the capacity to care for them. Not only is this a significant animal welfare issue, but reduced productivity and life expectancy increases their owners' impoverishment. Results from a recent Brooke funded study in Ethiopia revealed the important political, economic and social contribution that Equine ownership made to households, but, unlike livestock, the economic value of working equines is more difficult to articulate, particularly when used in subsistence farming systems.

In respect of the welfare challenges of working animals: poor working conditions, lack of resource provision including access to services such as effective animal health care and farriery are of prime importance and direct animal based indicators can be used to measure welfare changes using frameworks such as the 'five freedoms'. What is, then, the place of the animal health profession in improving welfare of working animals within the socio economic contexts? How can animal health care best be provided to working equids? What is the role of Government, Private vets, Paravets, Community Based Animal Health Workers (CBAHWs) and the owners themselves? Are undergraduate and postgraduate training courses producing vets with appropriate competencies?

Policy decisions and legislation also play a significant role in providing a framework for animal welfare and human subsistence. Can the International Non Government Organisations (NGOs) influence the development and implementation of working animal welfare friendly legislation and policies?

The paper concludes that there is a need to ensure that working animals are recognised as indispensable to the lives of poor people, playing a part in alleviating human poverty, in order to advocate for changes in policies and practice to improve their welfare.

Key Words: welfare, draught animals, transport and traction, equid, working animals, horse, donkey, mule.

Introduction

*“We know that for the whole world it might be only a donkey, mule or horse,
but for the marginalised poor owner it is the whole world.”*

Ganesh Pandey, Convener, Shramik Bharti, Kanpur, India

Working animals are often invisible on the agendas of governments and international institutions resulting in little attention being paid to improving their welfare except for specialist organisations such as the Brooke, an international equine welfare charity working with marginalised communities dependent on working animals for their livelihoods.

All domesticated animals could be said to “work” for the benefit of humans, whether that is through provision of food, transport, financial security, capital or companionship and leisure activities. Approximately 1 billion people, including many of the world's poorest, depend directly on animals for their protein supply, food security, transport, capital and draught power; as a proverb in the Horn of Africa goes: if the animals die, then the people will die too.

However, for the purposes of this paper, the working animals described are draught animals; those that perform transport

and traction activities. These are mainly working equids, camelids and bovinds, with the majority of examples given being from the working equine animal field, the authors area of expertise.

Use of Working Equids

Working equine animals support an estimated 300 million people globally, often in the most marginalised of communities. In rural communities they are used in subsistence farming systems to carry water, manure, firewood and animal fodder and to move households in the case of pastoral people. They are used throughout the range of agricultural activities from ploughing and sowing to harvesting and threshing, as well as the transport of agricultural produce.

In both rural and urban areas working equine animals are a major transport means both as pack animals and through pulling carts. They are used to transport goods to and from markets, farm inputs to farmsteads, children to school, the sick and women in labour to clinics and hospitals. Commercially these animals may be used as taxis or rented out to small businesses; industries such as building sites and brick kilns may own or rent large numbers of working equids. As an example: hotels in Cairo are all built with bricks that have been transported by donkey cart in the brick kilns of Helwan.

Many working animals (mainly equids and camelids) are used in the tourist trade, where they provide riding or carriage services to tourist sites, transport people on religious pilgrimages and provide food and drinks to tourist hotels and restaurants. In the export of high value products such as coffee and chocolate, working animals will often be the first link in the transport chain, moving goods to district and regional hubs for onward motorised transport. In Guatemala, for example, 85-90% of all coffee produced is transported on the back of a pack animal before export to the west.

Interdependence with Human Livelihoods

The importance of all domestic animals to the livelihoods of the poor is clear, however, more information is available on the role of livestock to livelihoods than on working animals. Previous studies carried out by the Brooke have identified that approximately 6 people depend on every working equid. The role of working equine animals in the lives of vulnerable groups such as women, children and the landless is also increasingly recognised. (Pritchard, 2011)

A recent study carried out by the Brooke in Ethiopia looked at the livelihoods of equine owning communities in Ethiopia (Admassu and Shiferaw, 2011). This study set out with the following objectives:

- To quantify income generated by equids out of the total household income.
- To quantify expenditure related to equids compared to other livestock.
- To quantify the labour contributions of equids and their income at the household level and socio-cultural contributions.

Results of the study showed the economic value of working equids to be considerable: The contribution to the household income of working equids was approximately equivalent to the household income from livestock farming. This estimate of income from equid use did not include equid use on homesteads, if this were taken into consideration; the income from equine use could be even more. Equine ownership also had important social functions, ranging from festive sport to ceremonial decoration during funeral services. Donkeys were considered as an animal that reduced the work burden of women. The social contribution of donkeys in reducing the work burden of women was 40% of all social values. Equine animals gave ambulatory services for both animals and humans, and were used to establish good relationships with neighbours and local societies through lending them whenever people were in need e.g. for threshing and private and societal works.

Other results showed that:

- The very poor did not own equine animals (with much of the extra burden falling on women if donkeys in particular were not owned).
- Equine related household expenditure was 6% of total expenditure.

- Richer wealth groups generated income through hiring out equids to others.
- Poorer generated wealth through using hired equids to make money (taxi services or goods carriage)
- Equine animals assisted poor households with income-generating opportunities and contributed to improving access to cash.
- There was a willingness to pay for quality animal health services.

More research into the links between livelihoods and animal welfare and between animal welfare and productivity is being carried out by the Brooke with an equine focus but more is needed to influence governments and institutions to include welfare in policies and strategies. It is often assumed that improving the welfare of working animals leads to their increased productivity and subsequently to improved livelihood for their owners and carers. It is true that some communities with working animals may be incentivised to improve the welfare of their animals by the idea that this will increase the productivity of the horse or donkey; however animals undertaking certain extreme work types such as elderly brick kiln donkeys or tonga (carriage) mules are already at the maximum capacity for work and attempts to improve their welfare are unlikely to result in increased productivity. Organisations working with these communities must therefore look to other solutions.

Welfare Challenges

The challenges to good welfare for working equine animals are numerous and it is important as vets to be aware of the wider welfare frameworks that do not just encompass physical health. A framework commonly used, and encompassing both physical and mental aspects, is the Five Freedoms developed by the Farm Animal Welfare Council [FAWC]:

1. Freedom from thirst, hunger and malnutrition by ready access to fresh water and a diet to maintain full health and vigour.
2. Freedom from discomfort by providing a suitable environment, including shelter and a comfortable resting area.
3. Freedom from pain, injury, and disease by prevention or rapid diagnosis and treatment.
4. Freedom to express normal behaviour by providing sufficient space, proper facilities, and company of the animal's own kind.
5. Freedom from fear and distress by ensuring conditions that avoid mental suffering.

The physical outcomes of poor welfare with working equine animals commonly include: wounds, colic, lameness and preventable infectious disease. However it is important to understand the mental outcomes that often manifest in behavioural difficulties.

Assessing welfare and welfare changes is of increasing interest, particularly in developing new and innovative ways of assessing changes. The Brooke has worked with Bristol University to develop a standardised tool which is used to provide baseline data at population level using a collection of animal based indicators and to measure the impact of interventions. More project specific indicators (at the animal level and the resource input level) are also used and empowering and participatory methods supporting equine owning communities to identify and measure changes in their animals' welfare themselves are increasingly prioritised.

The causes of poor welfare outcomes frequently identified for working equine animals include: poor nutrition and farriery, poor harness, overwork and inappropriate management practices which include beating and working animals at too young an age. Initiating factors are usually multi layered and include cultural and economic factors and those due to poor knowledge.

Cultural factors can include traditional beliefs (such as it being thought to be dangerous to provide water to a working animal) and harmful practices such as firing of joints and tendons (applying hot irons). The association of working animals with low socio-economic conditions and under development do not help the poor status of donkeys.

Knowledge, attitude and practices around the management and welfare of working equine animals may not be adequate; this is increasingly so where new communities start working with equids. Current expansion of donkey ownership may be to areas where equine management is not part of the traditional culture. Urbanisation often passes through a phase where working (draught) animals are used in small scale transport and commerce within towns and cities before laws eventually prohibit their use in the centre; these commercial units then move to the peripheries of the city. Often the people using these working animals are several generations removed from managing animals and welfare may be compromised. The Brooke works with communities to improve their knowledge around management practices such as water and shade provision, grooming and hoof care and basic first aid.

Economic factors commonly constrain marginalised communities from accessing resources such as feed and water, farriery and harness, appropriate shelter and health care for their working equid.

Service Provision

Improving the health and welfare of working animals requires a practical approach, grounded in the economic reality of the farmers, traders and householders who own and use them. The Brooke works on three elements to support effective provision of all services to working animal owning communities; for animal health service provision these are:

1. Creating a demand for the service through organising groups of animal owners, initiating group savings schemes and analysing locally available animal health services.
2. Improving a sustainable provision of an acceptable service; that is one that is available, accessible, affordable and of good quality. This includes influencing government vet services to include equids in their remit, training of service providers and building supply chains for resources
3. Linking between the service provider and the community (linking demand and supply). These links include individuals and groups of animal owners, government and private animal health service providers and training institutes.

Role of Vets

There are often challenges to vets providing effective services to working equids. Government vets may be poorly resourced, not available or accessible to the working animal owning communities. Private vets may have little incentive to work in the rural areas or with marginalised communities. Vets may also have received less than adequate training in equine medicine and surgery as livestock teaching is often prioritised. Delivery of animal health services involves many other actors from traditional healers, community based animal health workers to other paravets. The role of vets is therefore greater than just direct provision of curative and preventive services and includes capacity building of other vets and service providers. Empowering communities to develop welfare friendly handling practices as well as learning from communities should also be the responsibility of vets.

To develop these capacities it is important that undergraduate curricula and postgraduate training for vets includes the following skills: ethical decision making, animal welfare, equine handling, equine medicine, communication skills and legislation.

Policy/Legislation

Working animals are clearly critical to the lives of many poor and marginalised communities, although they are mostly invisible to policy makers. It is important to increase their visibility at local, national government and at international level so that their contribution to the livelihoods of the poor is recognised. Policies and legislation can then be enacted and enforced to provide working animals with the welfare they deserve.

There is a need for international guidelines or standards on working animal welfare and a recent Electronic consultation by the Food and Agriculture Organisation of the United Nations (FAO) and the Brooke gathered information and experiences

from a variety of participants on working animal issues including existing policies and legislation and gaps. This will lead into an FAO led Expert meeting in June 2011 which will document further any current knowledge. It is hoped that the World Organisation for Animal Health (OIE) will then take this information further to develop standards for working animals.

Conclusions

It is important to demonstrate the links between working animals and poverty in order to increase the profile of working animals to policy makers and ensure that pro working animal welfare policies are enacted and implemented. There is currently insufficient evidence on the links between welfare and productivity and welfare and livelihoods although current research by the Brooke will help to address this.

There is a need to ensure that all animals are recognised as being indispensable to the lives of poor people, playing a part in alleviating human poverty, in order to advocate for changes in policies and practice to improve their welfare. However, there are also encouraging signs that animal welfare, in general, is becoming recognised as necessary for success in international development.

The role of vets is crucial to the process but they often need to improve their own understanding of working equine welfare in order to play a greater role with communities and service providers. They will then be able to use an evidence based approach to better influence at government and international level.

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Animal Resources for Human Health in Rwanda

Theugen Rutagwenda

Director General

Rwanda Animal Resources Development Authority

P.O Box 804, Kigali

Rwanda

Rwanda has since May 2010 implemented a pilot school milk program known as the ONE CUP OF MILK PER CHILD. The pilot is implemented in 30 schools with children numbering 19,989 from nursery to primary three being given half a litre of milk per drinking that is twice a week for each child. The milk is from local dairy plants and since the program started, improvements in the dairy sector milk chain have been recorded. The price of milk paid to the farmers increased by 41% and preliminary results indicate that children on the program are enjoying drinking milk and even bring their young siblings who are not yet in school to share their milk and there are cases where children had dropped out of school but have now come back because of the program. The implementation strategies and impact of the program as well as plans to scale up the pilot will be discussed.

Rwanda has since 2006 implemented a program known as the ONE COW PER POOR FAMILY. This is where a poor family is given a pregnant cow, rears it and passes on the first female heifer to the next poor family and the program continues. The objectives of the programme is to reduce poverty as the cow gives milk that is consumed by the family to reduce malnutrition and the surplus is sold to generate cash income. The cow also supports crop agriculture as the manure is used to increase crop production. In addition, farmers rearing the cows are advised to plant pastures for the cows on terraces that are constructed on the hills that help to reduce soil erosion that is a problem for agriculture because of the nature of the terrain in Rwanda. In addition, the program leads to social harmony between the recipient families.

Since the program began, 106,000 families have benefited from this program countrywide. Milk production in the country has trebled and the country has been able to start a school milk program. The implementation strategies and impact of the program will be discussed.

Session 1: Animal Welfare Workshop

International Animal Welfare Standard Setting

Alejandro B. Thiermann

*World Organisation for Animal Health (OIE)
12, Rue de Prony, 75017 Paris
France*

The World Organisation for Animal Health (OIE) is the internationally recognized standard setting body for standards and guidelines on animal health and animal welfare. The development and adoption of international standards on animal welfare was undertaken by the OIE as part of the 4th Strategic Plan. The first standard on Guiding Principles for Animal Welfare was adopted unanimously by the OIE Members in 2004. Since then, standards have been adopted for transport (by sea, by land and by air); slaughter of animals, including religious slaughter; killing for disease control purposes; stray dog population control; and on the use of the animals in research and teaching. At present, standards on animal welfare in broiler chicken production will be presented for adoption during the General Assembly of May 2011. These standards and recommendations are based on scientific assessments, which have progressed rapidly in recent years. Aside from general recommendations, the OIE seeks for specific measures that lead to criteria and indicators that help in the evaluation of how different management and production of animals can influence their welfare. In addition to the development and adoption of science-based international standards on animal welfare, the OIE is interested in raising awareness on the subject and promoting the implementation of these standards by producers and regulators worldwide. Awareness on the importance of animal welfare standards is included among OIE's capacity building activities, especially through the identification of national animal welfare focal points, and their training at regional workshops. Proper animal welfare is an essential component of animal health, and will often improve productivity as well as food safety.

Towards the End of Factory Farming by 2050

Philip LyMBERy

*Compassion In World Farming
Second Floor River Court, Mill Lane, Godalming, Surrey GU7 1EZ
United Kingdom*

One of the greatest challenges facing humanity is how to feed a growing population in a warming world. This paper shows that greater intensification of livestock production would be counterproductive. It shows how industrial livestock agriculture presents serious threats to environmental sustainability, public health and animal welfare.

Over 60 billion farm animals are produced worldwide every year, the majority kept intensively, in ways that give rise to serious animal welfare concerns.

Livestock farming is a major user of land; it takes up 30% of the world's usable land area and consumes a third of the global grain harvest. Vast numbers of animals are now raised permanently indoors and are reliant on food grown elsewhere. Consequently, massive areas of land are given over to growing crops to feed them. Humans compete, not only with farm animals for precious grain resources, but also with cars, as biofuels take an increasing share of our croplands.

By 2050, the world's human population is predicted to increase to around 9 billion people. At the same time, the livestock population is set to double in the wake of growing demand for meat and dairy products, particularly from developing countries. The global livestock industry already contributes 18% of human-produced greenhouse gas emissions – more than the entire contribution of human transport. As the effects of global warming take hold, the sea is likely to rise and land will disappear. Plentiful, cheap oil, the essential ingredient of industrial agriculture, is likely to become scarcer and more expensive.

Thankfully, this predicted human population growth can be properly fed without industrial livestock production. Recent research concludes that free range and extensive farming can feed the world without swallowing up huge areas of wild lands. It outlines the ultimate win-win scenario: feeding the world's 2050 population without intensive agriculture is not only good for animal welfare but also provides environmental benefits such as promoting biodiversity and reducing environmental pollution.

This paper will explore the role of the veterinarian in securing global food needs whilst protecting animal welfare and ensuring a sustainable society.

The Big Idea

One of the greatest challenges facing humanity is how to feed a growing population in a warming world. This paper shows that greater intensification of livestock production would be counterproductive. It shows how industrial livestock agriculture presents serious threats to environmental sustainability, public health and animal welfare. Some ideas are so big and so radical that it takes time to take them in. Let's try this one for size: we could see the end of factory farming *worldwide* by 2050.

That may at first sound improbable, impossible even. We have become so accustomed to supermarket shelves laden with intensively farmed battery eggs, broiler chicken, pork, bacon, beef; that turning animals into production machines for cheap protein seems like an unalterable fact of life. But here's a thought. Factory Farming, as we have come to know it is rapidly approaching its very own 'sell by' date. Ever more pressing global problems are forcing a rapid rethink of the way we produce food for a hungry planet. If we stop to think about it, intensive livestock production is but a blip in the history of how world populations have fed themselves, a creation of the second half of the 20th century. It kicked off after the Second World War when ministries of agriculture in rich countries encouraged farmers to dump traditional, tried-and-tested farming methods and embrace new more 'efficient', more 'productive', more technological farming systems. It must have made sense at the time. The promise was that factory farming would create a world of plenty. And it came at a price.

Why is factory farming a big deal?

Despite the rise in awareness of farm animal welfare issues, there are more animals factory farmed in the world now than at any other time in history. Factory farming is one of the biggest issues of animal cruelty on the planet. Over 60 billion farm animals are produced every year, the majority kept intensively, in ways that gives rise to serious animal welfare concerns. Two out of every three farm animals in the world are now factory farmed. Kept permanently indoors; caged, cramped or confined. Treated like production machines rather than individual sentient beings. The root of the problem with industrial animal farming is, simply put, too many animals in too smaller space.

The global impact of factory farming is huge:

- 30% of the world's useable land area is used for rearing livestock.
- An area of land equivalent to the size of the European Union is used to grow feed for farm animals. Yet they waste valuable food. On average, to produce 1kg of animal protein requires nearly 6kg of protein in the form of feed grains.
- Every year, an area of forest equivalent to half the UK is cleared, largely to grow animal feed and for cattle ranching.
- A kilogram of chicken takes the equivalent of 22 bath tubs of water to produce; factory farmed beef takes 90 bathtubs of water to produce, much of it drawn from rivers and aquifers.
- Globally, the current livestock industry overall contributes 18 per cent of human-produced greenhouse gas emissions – more than the entire contribution of human transport. With factory farming as the engine room, livestock numbers are set to double by 2050.
- And keeping animals in such close proximity produces a pressure cooker environment for diseases such as highly pathogenic Avian Influenza.
- Battery cage farms for laying hens in the UK are six times more likely to be contaminated with Salmonella *Enteritidis* than non-cage farms.
- Half of all antibiotics produced in the world are used for farm animals.
- Factory farming breaks the link between livestock and the land. It is a fundamentally unsustainable way of producing food. It is also causes unbelievable suffering.

What is the outlook?

Let's take another look at some of the big trends to mid-century. If things continue as they are, by 2050, there will be:

- More people; an increase from 6.7 billion to about 9 billion people.
- More animals: the livestock population is set to double in the wake of growing demand for meat and dairy products, particularly from developing countries such as China and India. The global livestock industry already contributes 18 per cent of human-produced greenhouse gas emissions – more than all our cars, planes and trains put together.
- Less land; as the effects of global warming take hold, the sea is likely to rise and land will disappear. For food production alone, an additional two million square kilometers of land will be needed by 2030. Sea rise predictions due to climate change suggest that a similar area of land could be flooded by the end, if not the middle of this century.
- Less oil; plentiful, cheap oil, the essential ingredient of industrial agriculture, is likely to become scarcer and more expensive, unraveling the current economics of so-called 'cheap' meat.

- Less water; up to 2 billion people currently suffer from water scarcity – this is likely to increase to between 4 and 7 billion by 2050. Competition for water will be intense. Some even predict war as a result.

More animals, more people; less land, less oil, less water; how will that work? Far from a sustainable food future, it looks more like no future.

Factory farming has been the engine-room of the livestock explosion. It has enabled large numbers of animals to be reared in small spaces. And there's the rub. The world rarely gives something for nothing. Keeping too many animals in too small a space often brings about environmental degradation and threats to our health as well as unimaginable animal suffering.

We are now moving to a world where there could be too many farm animals on too smaller planet

The strain is already beginning to show. We are beginning to see shortages of staple foods like wheat and rice caused by climate change, the biofuel goldrush, and the growing taste for a more Western diet, rich in meat and dairy, in rapidly developing countries, so there is an ever increasing competition for food between humans and animals and now cars.

More people, more animals; less land, less productive land, and the props that have sustained factory farming, such as a cheap, plentiful oil - kicked away.

It brings into sharp focus that longstanding ethical question: Is it right to feed a large proportion of the world's grain harvest to livestock when wheat and rice prices are so high that many people in poorer countries can't afford them?

So what's the answer?

The answer lies in realizing that, fuelled by factory farming; the rich world is eating too much meat for its health, for the environment and for animal welfare. If we are to stabilize farm animal numbers we need to move away from last century factory farming toward a new 21st Century model of humane and sustainable farming: Where fewer animals are kept more humanely; greatly reducing the amount of water, land and energy needed to feed them.

For consumers, this new farming approach would mean eating less, but healthier milk and meat from compassionately-reared animals. Instead of eating factory farmed protein every day of the week, we would eat the humanely and extensively-reared alternative, around twice a week.

Pasture-reared versus grain-fed

So, what will we be eating on the sustainable restaurant table of tomorrow?

As the battle against factory farming intensifies, the debates will sharpen between those who believe in the industrial grain-fed, animal confinement industry and those who believe, as we do, that a vision of a humane and sustainable future will manifest in the pasture-raising of animals.

With a third of the world's grain harvest already being fed to farm animals worldwide, most of them factory farmed, it is clear that industrial animal agriculture is not only about animal welfare, but also about huge wastage of essential food. Especially when we realise that animals waste protein rather than make it. In other words, on average, grain-fed animals use six tonnes of feed to produce one tonne of meat. When it comes to soya, the majority of global production is used to feed farm animals. The environmental and food waste consequences are significant. As Alex Renton recently put it in the British newspaper, 'The Times,' "Cheap, soya-fattened, highly processed animal protein, shipped across the world, does far more damage than a steak from the grass-reared herd on a traditional farm a few miles from your local butcher."¹

There are those who will try to assert that animals are better off indoors, kept intensively on an industrial farm, than outside on pasture. This, of course, is nonsense. There is a half-way house, and that is keeping animals in more environmentally enriched systems and more extensive systems indoors. For example, chickens reared to the Royal Society for the Prevention of Cruelty to Animals (RSPCA) indoor extensive standards, where the birds are given more space, a better environment and are not pushed to grow so fast to the detriment of their bodies. And then there is the absolute prerequisite for good welfare

on any farm, and that is that animals are properly looked after in well managed farming systems if they are to thrive.

However, that animals do well outdoors is well described. One of the best analyses I've seen on this subject recently was published by two ranchers, Bill Niman and Nicolette Hahn, from California, USA, in an article entitled, 'For animals, grass each day keeps doctors away' The article can be summed up by the quote, "fortunately for farm animals, farmers, and consumers, the overwhelming body of scientific evidence confirms what common sense already tells us: animals are happier and healthier when raised with sunshine, fresh air, and grass, and given the opportunity to exercise. Not surprisingly, animals raised on pasture also produce healthier and safer (not to mention tastier) food."²

As farmer Richard Young points out in the book, 'The Meat Crisis', there is a growing body of evidence to suggest that the way animals are reared affects the quality of the meat³. A recent review of the published science has found that grass-fed beef is lower in fat and a healthier composition than grain-fed beef⁴.

'Cheap' chicken is no longer the low fat option that many believe it is. A typical supermarket chicken today contains nearly three times more fat than in 1970. During the same period, the protein content of a typical factory-reared bird has dropped by 30%. Indeed, they have now been shown to contain more fat than protein. Compare this with an organically reared chicken, which has 25% less fat than an intensively reared bird and has the protein/fat ratio round the right way. You can see that the way a bird is reared really can make a difference to the quality of the food produced.

And then there is the role that pasture can play in mitigating climate change. The Intergovernmental Panel on Climate Change's (IPCC) scientists have recognised that soil carbon sequestration represents 90% of agriculture's climate change mitigation potential. More extensive mixed farming systems with pasture are well placed to realise this potential; to help mitigate climate change, as well as deliver better quality food and animal welfare.

Peter Roberts And Feeding The World - 1989

Compassion in World Farming (Compassion) has always had a forward thinking vision, thanks to our founder, Peter Roberts, who has often been described as being ahead of his time. Seeing the growing disparity between feeding the world's people and the capacity to do so on a meat-based diet, Peter wrote:

"We must progressively reduce our dependence on animals and gradually relegate them to the less productive land."

"It will be necessary to re-allocate the most productive land for the production of primary foods – that is to say, foods for direct human consumption without being processed through animals."

So, back to that sustainable restaurant menu of 2050; what will be on it? We will be eating pasture-reared beef and lamb, as well as free ranging pigs and poultry. The quality of our food will be all the better for moving away from intensive grain-fed industrial-produced meat and dairy. Although we'll eat less of it, particularly pigs and poultry, our diet will be healthier and more balanced.

Can we feed the world without factory farming?

The big question is; can we feed the world without factory farming?

And the answer? We don't need to be cruel to farm animals to feed people, now or in the future. That's the conclusion of "Eating the Planet,"⁵ our latest research commissioned jointly with Friends of the Earth (UK). The report was produced for us by the Institute of Social Ecology in Austria and the Potsdam Institute for Climate Impact Research in Germany.

1 RENTON, A., 2010. *All this cheap meat will cost the Earth*. *The Times*.

2 NIMAN, B and N. HAHN., 2010. *For Animals, Grass Each Day Keeps Doctors Away*. *The Atlantic*

3 R. YOUNGS cited in D'SILVA, J and J WEBSTER. 2010. *The Meat Crisis: Developing More Sustainable Production and Consumption*. Earthscan Ltd, London, p93.

4 ERB, K-Het al, 2009. *Eating the Planet: Feeding and Fuelling the World Sustainably, Fairly and Humanely- a scoping study*. *Social Ecology Working Paper 116*.

It concludes that free range farming can feed the world without swallowing up huge areas of wild lands. It outlines the ultimate win-win scenario: feeding the world's 2050 population without intensive agriculture is not only good for animal welfare but also "provides environmental benefits such as promoting biodiversity and reducing environmental pollution."

Our planet is under increasing pressure. We face the double problem of increasing human land use and climate change. Both may well undermine our ability to feed everyone. Feeding the world sustainably, fairly and humanely in the coming decades, as the report says, is therefore "one of the greatest challenges facing humanity."

Eating the Planet's key findings are:

- Feeding the world in 2050 is possible without using the most intensive forms of animal and crop production or a massive expansion of land for farming
- Humane methods of farming animals can provide sufficient food to feed a growing world population
- Providing sufficient food for all would be helped greatly if rich countries adopt healthier, lower meat-based diets and food is distributed more equally
- Sufficient food can be provided in 2050 without further deforestation.

What kind of food and farming for 2050?

Here's a news flash; the kind of farm that we will need tomorrow is with us today! Trouble is, that kind of farm is being run by one of the most threatened species on the planet; the humane and sustainable farmer.

You see, for every humane, sustainable, extensive farm that is set up worldwide, six industrial farms are being established. What comes with these farms is not only an unsustainable hunger and thirst for water, food and oil resources, but also an approach that transforms the precious into bland commodities with declining value. Farm animals are transformed from 'sentient' creatures, with their own wants and needs, into units of production. Autonomous farmers become 'contract growers' in the pursuit of shrinking margins. Biodiverse mixed farms become monocultures, wildlife deserts. Dairies become industrial mega-farms where basic biology – that cows eat grass – is denied and the cows are kept inside.

I believe that it is time to eradicate factory farming. To bring an end to the wastefulness, the damaging and the cruel practices inherent in the industrial farming model. That devalues our food and undermines food quality. Instead, I believe we should stand up for the humane and sustainable farmer whilst we still can; to stop them going extinct. To prevent our food system from irresponsibly mortgaging the future, whilst squandering the natural capital that we will need to feed ourselves tomorrow.

In conclusion

Over the coming decades, a paradigm shift in our attitude toward animals at policy level is needed for the benefit of food security, the environmental sustainability and the animals themselves. Factory farming is not the way to feed the world sustainably. The intrinsic value of animals in our society should be recognised; denying this places global food supplies and ecological balances in grave danger.

Key strategic objectives are:

- Policy action to encourage ongoing consumption to switch from intensively-produced meat and dairy to more extensively produced food.
- A 30% reduction below current levels of consumption of meat and dairy products in developed countries by 2020

5 *COMPASSION IN WORLD FARMING and FRIENDS OF THE EARTH, November 2009. Eating the Planet? How we can feed the world without trashing it.*

- Governmental and intergovernmental targets and incentives to support a reduction in meat consumption in developed countries – an international treaty for example
- Recognition that meat and milk are under-priced in relation to their real environmental and carbon costs and their impact on public health and animal welfare
- To encourage and support developing countries to avoid the further uptake of factory farming systems

Yes, ending factory farming worldwide by 2050 is a big idea. But there is nothing stronger than an idea whose time has come...

It's time to make that idea a big reality. And bring about a world where:

- Farm animals are treated with compassion and respect
- A world where farming protects our wildlife, the climate and our health
- A world where all people everywhere have access to decent, affordable, healthy food.

Together, we can turn this idea into that big reality.

Role of EU in Sustainable Livestock Development in Africa – A Welfare Perspective

A. Gavinelli, M. Ferrara and M. Knypinska

*Animal Welfare Unit
Directorate General for Health and Consumers
European Commission
Brussels*

According to the statistical data, there were 925 million hungry people in the world in 2010, which is 13.1 percent of the global population¹. With over 70% of the world's poor living in rural areas, support to agriculture and rural development is fundamental for reducing poverty and boosting growth. Moreover, up to 90% of the population in many developing countries depend on agriculture and farming for their living, as these provide income, employment and food, as well as raw materials for industry and exports.

In this context, developed countries have the duty to help suffering regions by promoting food security strategies and rural development programs, which strengthen support for smallholder farmers and contribute to poverty eradication. The European Union considered as the second global economy, has been involved in development and sustainability programs for many years aiming at reducing poverty, delivering aid through the world, increasing food security and protecting natural resources.

Animal welfare is a component of EU policies and is considered to be an integral part of agriculture. The EU policies on animal welfare are devoted to animals kept on farm, in transit and at slaughterhouses and their main goal is to ensure them good living conditions. In this context, the role of the EU in sustainable livestock development in countries with emerging economies, such as Africa, should therefore be considered also from an animal welfare perspective.

Animal welfare policies are founded on a common value, being the belief that the life of people is strictly related to the life of animals. In particular, the concept of animal welfare is perceived as strictly related to sustainable development where improved animal welfare creates business opportunities for farmers as well as for trade within the EU and worldwide.

As it was highlighted at the “Conference on Global Trade and Farm Animal Welfare”² organised in January 2009 by the European Commission, there are many competing and complementary issues interacting on the farming of animals at global level; starting from remaining competitive in a global marketplace, to the delivering of food for which the demand is projected to double by 2050 and responding to consumers preoccupations on several issues such as animal welfare and last but not least the challenge of climate changes. There are forms of farming in intensive conditions so poor for the welfare of the animals that are likely to be not acceptable at global level³. In this context, international consensus exists that higher animal welfare standards should be promoted globally, in particular to open new market opportunities for countries with emerging economies, and that “animal welfare should not be treated as a stand-alone issue but as one among many socially important goals including food safety and security, human and animal health, environmental sustainability, worker safety, rural development, gender equality, and social justice”⁴.

In this context, the EU should therefore ensure access to its markets for welfare-friendly products, by offering trade-related assistance and capacity building to developing countries together with information, training and mentoring in the

1 <http://www.worldhunger.org/articles/Learn/world%20hunger%20facts%202002.htm>

2 http://ec.europa.eu/food/animal/welfare/seminars/index_en.htm#2009

3 Gavinelli, A., Ferrara M., (2009). Chapter “Animal welfare: the risk manager’s perspective”, in “Welfare of production animals: assessment and management of risks”. Food Safety Assurance and Veterinary Public Health (Volume 5), Wageningen Academic Publishers, October 2009.

4 Food and Agriculture Organization of the United Nations (FAO), 2009. Capacity building to implement good animal welfare practices. Executive Summary FAO Expert Meeting, FAO Headquarters (Rome), 30 September - 3 October 2008. Available at http://www.fao.org/ag/AGInfo/resources/documents/AW/AW_Exp-meeting_EN.pdf

development and maintenance of good welfare standards on-farm, during transport, and at slaughter⁵.

In this light, the European Union for many years now is in charge of various types of initiatives towards global animal welfare awareness in particular as regard delivering quality in animal production while respecting good health and welfare of the animals. Animal welfare policy requires investments in order to improve farming infrastructure but also to improve skills and technical knowledge of producers and farmers. Important part of the AW strategy is a proper communication to consumers on ongoing activities and raising their awareness of ethical and quality value of animal welfare products.

Besides ad hoc activities, campaigns and promotion missions, the EU ensures welfare of animals through the legislation. According to Article 13 of the Lisbon Treaty, animals are recognised as sentient being and their welfare should be taken into account whenever formulating and implementing the Union's crucial policies. The animal welfare legislation has been evolving since 1974, when the first, European scale, legal act concerning stunning and killing of animals was adopted. Up to day, there are in place directives, regulations and Commission decisions regulating transport, experiments, farming of various species of animals. On top of that, in 2006 the European Union adopted the Community Action Plan on the Protection and Welfare of Animals that enhanced the period of 2006-2010. On 19 January 2012, the Commission adopted the new European Union Strategy for the Protection and Welfare of Animals 2012-2015⁶.

The Community Action Plan stated that the EU should engage and assist developing countries in implementing animal welfare measures, in order to create a win-win situation for all actors. The new strategy builds on the first action plan and on the lessons learned during its five-years implementation, in particular boosting the international cooperation.

In this context, the EU Commission continues to work with international organisations such as the World Organisation for Animal Health (OIE) for promoting the development and implementation of internationally recognised animal welfare standards as well as with the Food and Agriculture Organization of the United Nations (FAO) for supporting capacity building activities on animal welfare in countries with emerging economies.

These activities are based on the vision that, in order to collaborate on the improvements and implementation of animal welfare standards, we need to reflect on equivalent systems rather than identical ones. With this vision and for several years now, the Commission has been actively promoting and discussing animal welfare issues and the prospect of internationally recognised animal welfare standards globally. Several positive achievements have been reached by considering animal welfare into bilateral and multilateral veterinary agreements (e.g. with Chile, Canada, Korea), by establishing technical cooperation forums (e.g. New Zealand, Australia) and by supporting technical initiatives and conferences all around the world, from Latin America to China and Africa. These activities as well as specific training programs such as the Better Training for Safer Food Africa reflect on the benefits and opportunities of improving animal welfare practices and standards as well as consider animal welfare as an added value to trade while delivering food quality and respecting the regional and local dimensions. In addition such activities serve as a platform for stakeholders to meet and exchange views and experiences.

The European Union, by all the abovementioned activities, plays an important role in trendsetting animal welfare at global level and contributes to the development and sustainability also in Africa, in particular through its Food Security Thematic Programme. Undoubtedly, integration of the animal welfare concept to the food security and development programs is very challenging and is a step-by-step process. And obviously, the establishment of equivalent market conditions between EU operators and those from third countries is still a long-term project where the implementation of multilaterally agreed animal welfare standards, while respecting the regional and local dimensions as well as the international acceptance of animal welfare practices, should be based on identification of risks and equivalent systems, good practices and "outcomes". Therefore the further development and implementation of animal based welfare indicators are considered in the new EU Strategy as a priority to facilitate the assessment of animal welfare in different farming conditions, facilitate their comparison and engage with Third Countries, particularly those with emerging economies, to improve animal welfare and related livestock livelihood globally.

Such potential integration of animal welfare and its added value were also emphasized by the International Finance

5 Gavinelli, A. and Park, M., 2007. *Farm Animal Welfare: In Legislatures, Corporate Boardrooms, and Private Kitchens. The State of the Animals IV: 2007.*

6 http://ec.europa.eu/food/animal/welfare/actionplan/actionplan_en.htm

Corporation stating that: “Higher animal welfare standards are also increasingly seen as to be a prerequisite to enhancing business efficiency and profitability, satisfying international markets, and meeting consumer expectations”^{7,8}.

According to the evaluation assessments of the EU strategy on animal welfare, the EU’s international initiatives have indeed helped to raise awareness and create a shared international understanding of animal welfare issues and standards.

The EU Commission will therefore continue to build its international policies on such a formula where WTO rules, competitiveness issues for European producers, transparent consumers information on the farming systems applied, food safety, ethical and non trade concerns, are integrated with animal welfare concerns as well as with sustainable development programs.

7 International Finance Corporation-World Bank Group, 2006, ‘Animal Welfare in Livestock Operations’, Good Practice Note, October 2006, no. 6. Available at, [http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/p_AnimalWelfare_GPN/\\$FILE/AnimalWelfare_GPN.pdf](http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/p_AnimalWelfare_GPN/$FILE/AnimalWelfare_GPN.pdf). Accessed 2 June 2009.

8 International Finance Corporation-World Bank Group, 2006, Quick Note: Creating Business Opportunity through Improved Animal Welfare. Available at, [http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/p_AnimalWelfare_QuickNote/\\$FILE/Animal+Welfare+QN.pdf](http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/p_AnimalWelfare_QuickNote/$FILE/Animal+Welfare+QN.pdf). Accessed 2 June 2009.

Defining the Role of the Veterinarian in Animal Welfare

Duane Landals

*World Veterinary Association
RR1 Site 2 Box 2, Onoway, Alberta
Canada*

Defining the role of the veterinarian in animal welfare is as complex a task as actually defining animal welfare. The commonly accepted interpretation is that animal welfare is a term that refers to the state of the animal itself. A wide range of other terms, such as; animal care, management, handling and so forth are used to describe processes that lead to acceptable animal welfare. Providing appropriate veterinary medical care, nutrition, disease prevention, transportation and ultimately a humane death, are all tasks that must be properly provided for if the state of good welfare is to be achieved by the animal.

Likewise, facilitating animal welfare may be considered the very state of being a veterinarian, as defined by professional responsibility. Additionally, however, there are a growing list of tasks or services that require the engagement of veterinarians to insure society reaches and maintains an acceptable level of animal welfare. The veterinary community must identify the current needs and forecast future needs to insure that we have the properly trained human resources and necessary skills and tools to uphold the obligations of the profession.

Defining the role of the veterinarian in animal welfare is as complex as defining animal welfare itself. In the 2009 Terrestrial Animal Health code, the World Organization for Animal Health (OIE) asserts that animal welfare means how an animal is coping with the conditions in which it lives. An animal is in a good state of welfare if it is healthy, comfortable, well nourished, safe and able to express innate behavior, and if it is not suffering from unpleasant states such as pain, fear and distress. The code goes further to relate that there are a number of requirements to achieve good animal welfare. These requirements include; disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter/killing. The conclusion is that animal welfare refers to the state of the animal while the treatment that an animal receives is covered by other terms such as animal care, animal husbandry and humane treatment.

This same argument may be extended to a consideration of the veterinarians role in animal welfare. By virtue of being identified as a member of the veterinary profession, an individual accepts a set of principals in regards to animal welfare. These principals of the profession are captured in a variety of codes of practice, ethics and various veterinary oaths that are adhered to in different regions.

An excerpt from the Canadian Veterinarians Oath states "I will strive to promote animal health and welfare, relieve animal suffering, protect the health of the public and environment, and advance comparative medical knowledge." Another example cited is from the legislation of the Province of Alberta, in Canada.

The *Veterinary Profession Act* creates a veterinary statutory body, responsible for the registration and ethical behavior of individuals entitled to practice veterinary medicine in that jurisdiction. In the section outlining the ethics of the profession, it is required that "a registered veterinarian should be dedicated to the benefit of society, the conservation of animal resources and the relief of suffering of animals." This type of professional and regulatory commitment is common to members of the veterinary profession world wide. So, like the statement that animal welfare refers to the state of the animal, it may be considered that attending to animal welfare is the accepted role of the veterinarian simply by virtue of being a veterinarian.

In addition to being animal welfare advocates by virtue of being a veterinarian, there are a wide range of jobs or tasks that different veterinarians undertake that support and promote animal welfare. These occupations often parallel the OIE definition in regards to the treatment an animal receives in arriving at a state of good welfare (disease prevention, veterinary treatment, shelter, management, nutrition, humane handling and humane slaughter/killing).

It is commonly recognized that the activity of veterinarians is evolving. In anticipation of World Veterinary Year, the Vet 2011 committee is quoted as saying; "modern veterinarians are not only animal doctors and animal welfare advocates, they are also key public health stakeholders because of their crucial role in: reducing global hunger, controlling zoonoses,

monitoring food quality and safety, biomedical research, and protecting the environment and biodiversity”.

While the careers of veterinarians are certainly changing, likewise the field of animal welfare is changing. Conventionally the philosophies of people in regards to animal welfare are broadly divided into five categories.

- abolitionist philosophy: animals have the same rights as humans and should not be used for any purpose, what so ever.
- animal rightist philosophy: animals should not be used except when that use benefits the animal. Limited use of animals may be permissible when a mutual benefit between animals and mankind can be demonstrated.
- animal welfarist philosophy: Humans have the right to use animals but have a responsibility for animal well being and must provide for physiological and behavioral needs of animals.
- utilitarian philosophy: the right action is what benefits most individuals. Using animals for the benefit of people is acceptable.
- dominionist philosophy: people can do what ever they want to animals because humans are the only species with rights.

Animal welfare standards are often unique to a region and may vary considerably between regions. These standards are determined by a multitude of factors, including; the values and beliefs, cultural and religious considerations and economic and educational standard of an area. Despite these differences, every region has a normal set of standards to which the majority of the population adhere. At the same time, there will be individuals who adhere to philosophies ranging to either side of the average demographic for the area. It is also evident, that while the average standard of animal care may vary considerably, all locations are gradually moving their average standard of care in a direction that is more considerate of animals. This shift in global concern for animals comes from many different stimuli. Commonly, as the wealth of a region increases, the inhabitants have more free time and less concern about the security of the food supply. This allows an opportunity for development of stronger human animal bonds and greater reflection upon how the animals that serve mankind have actually been treated. Increasing global human populations have prompted changes in agricultural practices. Aspects of the various production systems, combined with the transport and slaughter of increasing numbers of animals, raise a wide range of welfare issues. Modern science and veterinary education, is reinforcing the concept of animals as “sentient beings” increasing the need to safeguard animal welfare. All these factors have converged and result in increased societal concern and demand that animal welfare issues be addressed.

At a notable leadership level, the OIE has formally recognized that “there is a critical relationship between animal health and animal welfare.” Subsequent to the hosting of its first Global Conference on Animal Welfare in 2004, the OIE published a scientific and technical revue entitled “Animal Welfare: Global Issues, Trends and Challenges”. Following this came the inclusion of animal welfare in the 2009 Terrestrial Animal Health Code. This undoubtedly is resulting in an increasing link between trade and market access with animal welfare.

In 2008 the food and Agriculture (FAO) published the report of its expert committee that met to consider the impact of animal welfare issues. The experts are quoted as saying “the FAO recognizes the importance of animal welfare practices that lead to benefits for both people and their animals and supports their implementation.” With this keen interest being expressed by these two major, global policy setting agencies, it is not difficult to see that the requirement for qualified veterinarians in the field of animal welfare is expanding well beyond their traditional roles.

In their every day dealing with animals, veterinarians must always adhere to the principals of care and compassion. This is being expressed by the development of effective pain management products and protocols that allow routine veterinary procedures to be performed with less duress to the patient. Equipment enhancements, refined procedures and techniques, along with staff training are all being employed as mechanisms to insure that veterinary practitioners carry out their activities in an animal compassionate manner. This is considered a professional obligation for any member of the veterinary community.

Veterinarians are also called upon to use their knowledge to educate their clients and other members of the community in regards to correct animal production procedures so that welfare might be enhanced. In addition to specific training, they must foster and promote best animal management practices and an understanding of the benefit from and need for these practices.

As the need for welfare standards and assurance programs increases, there is a role for veterinarians to play in both their development and implementation. Whether these are voluntary codes, corporate programmes, legislated standards on a regional basis or international agreements between countries, there is a need to insure that the program is useful, that it is faithfully adhered to and that the public can trust its validity. Veterinarians have the scientific and medical training as well as the statutory accountability to assume roles in this field.

It is evident that further scientific research is necessary in basic welfare understanding as well as applied research in determining the best production practices to enhance both animal welfare and food production. Qualified veterinarians are required to work with other scientific experts in a variety of capacities in this field.

Certainly we can expect countries to continue to expand upon existing animal welfare legislation or to draft new laws. The role of the veterinarian in helping this development is paramount, so that this legislation truly serves societal need as well as the needs of the animals.

It is easy to accept the conclusion of the FAO that “animal welfare should not be treated as a stand-alone issue but as one among many socially important goals, including; food safety and security, human and animal health, environmental sustainability, worker safety, rural development, gender equality and social justice.” Equally significant are the areas of high priority in animal welfare identified by the FAO as: transportation, slaughter (including pre-slaughter management), food and water, handling and herding methods, culling and disposing of animals that are sick or of low commercial value, and keeping animals under conditions for which they are not genetically suited. If one compares this expanding requirement for animal welfare expertise with the acknowledged expanded scope of interest of veterinarians, it is obviously that they line up very closely.

The conclusion should be drawn that the role of the veterinary profession in regards to animal welfare now expands well beyond simply doing things properly yourself, the veterinary profession has great potential, opportunity and responsibility to engage in a wide range of employment fields that deliver animal welfare services to the benefit of society and ultimately all animals.

The veterinary community as a whole must identify current needs and forecast future developments to insure that we have the properly trained human resources, as well as the necessary skills and tools to live up to the expectations and obligations of the profession in regards to animal welfare.

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Animal Welfare and Natural Disasters - An Italian Experience

Paolo Dalla Villa

*Istituto G. Caporale Teramo
Via Campo Boario 64100 Teramo
Italy*

Introduction

The human-animal relationship has important emotional and social implications, especially during emergency situations, and it can be a decisive factor affecting individual reactions to disaster (Beaver et al., 2006). Awareness of animals in distress or danger can impair the people's capacity to cope with family tragedy or severe personal hardship. At 3:32 am on April the 6th 2009, an earthquake of 5.8 on the Richter scale, with the epicentre in L'Aquila, the regional capital of Abruzzo, caused the death of 306 people, the injury of another 1.500 and forced around 65.000 people to abandon their homes, making more than half of them to live in temporary tent cities for several weeks. The severity and extent of the disaster hugely damaged most of the health facilities in L'Aquila and caused enormous personal hardship to workers at the Local Health Unit (LHU), affecting the activities of the Public Veterinary Services (PVS). The Istituto 'G.Caporale' Teramo (ICT) was asked by the local Red Cross to provide professional and logistic assistance from the early morning of April the 7th. After an initially uncoordinated response to the ever-growing demand for veterinary assistance from the animal owners, the local community and rescue volunteers, the ICT Director was appointed by the National Civil Protection Department to coordinate the veterinary crisis unit. A prompt and broad response was given to the call up for human resources by public institutions, breeders' associations, animal welfare groups and private professionals. The ICT was able to provide professional skills and competencies on animal health and welfare, urban veterinary hygiene, information technologies, veterinary training and laboratory diagnostics, supplying all the necessary tools to restore communications and to maximize the efficiency of the emergency management system. A specific action-plan was set up without the benefit of any pre-existent contingency plan, equipment and logistic resources, nor any specific communication system. The veterinary crisis unit, called "Veterinary Action" (VA), comprised 3 independent but interconnected subunits; 'Food Safety', 'Farm Animal Health & Welfare' and 'Companion Animal Health & Welfare'. Within 72 hours a surveillance system was implemented, in order to reduce the negative impact of the disaster on public health and safety as well as on animal health and welfare. This tool enabled the VA to collect and analyze the information needed to quickly restore, and possibly to improve, the pre-existing conditions and to evaluate the impact of the emergency plan on the evolving situation. The main tasks of the 'Animal Health & Welfare' subunits, operating in the area affected by the earthquake, were to verify critical issues and management needs of livestock, to esteem and control the owned and stray dog and cat populations and to provide with veterinary assistance, shelter, feed and medicines, both companion and farm animals.

Farm Animal Health & Welfare emergency action

The "Farm Animal Health & Welfare" VA unit efforts were aimed at a quick recovery of the local zootechnical production system. To achieve this purpose, qualified personnel was needed and the urgent demand for human resources encountered a positive unanimous response. All the livestock production stakeholders got involved by AV in the emergency actions. PVS, private veterinarians, stock breeders associations and local farmers collaborated together in a proactive way. The on field activities were planned according to a step by step approach: the development of an information system (to manage the information about the encountered situation and the impact of the assistance provided), the inspection of the damaged farms and the care of food animals, including collection, feeding, sheltering and slaughtering. The inspections were performed starting from the farms placed in the epicentre (that were the most affected by the earthquake and therefore in need of more prompt help) and then continue moving on a centrifugal direction. Daily inspections were performed by a total of 27 veterinarians divided in teams, each one formed both by ICT veterinarians and private ones, with proven experience on livestock and animal production hygiene. From April the 10th 2009, 2.036 farms were visited in 35 municipalities around the affected area, the 72,8% of them being carried out within the first 15 days from the disaster. A specific evaluation form had been used during the inspections, in order to perform the livestock census, the counting and identification of dead or emergency slaughtered animals as well as the disposed livestock carcasses, the safety condition of the farm premises, the

equipment functionality (i.e. food dispensers, milking facilities and equipment, milk storage and transport), the potential lack of stockmen and the need of food and water supplies. The collected data were handled with a GIS-based software application allowing to locate all the farms in the area of interest, to record all information gathered through the inspections and to elaborate a detailed data report. This approach was crucial in order to properly assess the needs and resources availability and to define the priorities for feed and drugs distribution, for finding new animal housing solutions to homeless livestock and to activate new marketing channels for the local zootechnical productions. The most critical issue, emerged from data analysis, regarded milking system and milk storage facilities adequacy, because of their possible implications on food safety and quality. Another main critical point was the on-farm feed availability. To solve this problem, a storage/distribution center for zootechnical feedstuff was built on a vast and easily accessible area. Veterinary pharmaceuticals company participated to the emergency actions offering their products, which were stored and distributed by the Teramo School of Veterinary Medicine, in cooperation with private veterinarians.

Companion Animal Health & Welfare emergency action

The likelihood that many companion animals required timely assistance following the earthquake made urgent a fast organisation of the rescue and assistance activities. For the effective planning of veterinary interventions it was necessary to establish the size and composition of the local dog and cat populations (Di Nardo, 2007). The Canine Regional Register was used as a reference to define the overall number of dogs (both owned, stray and community dogs), but it resulted to be uncompleted in many cases. Therefore, in order to improve the companion animal population esteem, repeated census were performed in the tent cities and data were compared to those collected in the immediacy of the earthquake. The situation encountered regarding cat population was even more complicated, because of a total lack of a Cat Register. Stray cat colonies had been geo-referenced with GIS technology and cat feeding points were strategically disseminated on the territory in order to allow a better control of the animals. A helpdesk was activated at the ICT headquarters in Teramo to log, select and manage veterinary assistance requests and to find temporary accommodations for the lost or unattended animals. The helpdesk dealt with different issues, mainly related to lost & found animals, fostering and adoptions requests. A collaborative network of the leading national animal welfare associations was activated and permanently represented in the VA team. Volunteer teams were deployed in order to monitor the presence of free-roaming, injured or trapped animals; to inspect and assess the animal housing conditions; to distribute animal feed and medical supplies in the tent cities; to inform the public opinion about the services offered by VA and to promote the responsible ownership concept. Cages, beds, collars, carriers, modular boxes and dietetic feeds were distributed to ensure that pets were accommodated at best. Veterinary assistance was also needed in order to microchip and register owned and free roaming dogs and to spay/neuter stray animals. In tent cities, 1395 pet dogs were identified and registered; they were also identified with fluorescent collars and treated monthly with external parasiticides. Despite the offer of free sterilisation, this procedure was requested for only 175 animals, confirming that the cultural attitude of owners toward sterilisation of pets is one of the most important obstacles to its use (Fournier and Geller 2004). Moreover the forthcoming seasonal reproductive cycle of cats made it a top priority to halt rapid feline population increase through spay/neutering programs.

Discussion

Location, intensity and duration of natural disasters like earthquakes are impossible to predict. Their consequences are often amplified from pre-existing factors, rather than the effects of the calamity itself (Heath et al., 2001). Since the very beginning of the L'Aquila earthquake emergency management, the main problems raised because of an incomplete knowledge about the number and localisation of farm and companion animals on the territory. The National Data Bank for Livestock Registration and the Canine Regional Register could have been, if properly implemented, an essential tool to esteem the real size, composition and structure of the local animal population, allowing an effective emergency response. Unfortunately, the AV had to deal with a poorly updated information systems, where most information were missing. For this reason, it was essential to collect all these data in order to set up an effective and efficient emergency action plan. Furthermore, a relevant number of stray cats and dogs was already present on the territory prior to the earthquake. This situation threatened to become a significant ecological and health problem in the earthquake area, especially in relation to the presence of the tent cities as potential new sources of food for the animals and the new availability of shelter in unsafe, collapsed or abandoned buildings. The need of prompting the reinforcement of local surveillance and control emerged, in order to reduce health hazards (spread of zoonoses, dispersal of waste, faecal pollution), prevent human directed aggression

episodes and possible predatory actions of farm animals by stray dogs. On the other hand, regarding livestock, in addition to the above mentioned problems emerged by lack of data in the database, important economic matters came out. In fact, although direct damages to farmers were relatively limited, indirect damages were considerable and long-lasting. The massive population displacement into the temporary accommodation facilities heavily compromised the zootechnical products marketing in the province of L'Aquila. Farmers and breeders were not able to place their products and no plans were foreseen in order to help a rapid recovery of the local economy. The described scenario made it possible to develop and test the efficiency of an integrated system with specific skills and objectives, built around the participation of all the different figures involved in public veterinary health, including private veterinarians, supported by local institutions and working alongside with the animal welfare associations. For the future, the construction of international guidelines will be essential in order to prepare risk-based, all-hazard emergency management plans and to define standard operating procedures. Following the development of these procedures, specific training including the use of novel e-learning tools and simulation exercises should be undertaken, in order to test the intervention capability.

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Animal Welfare in Developing Counties – Constraints, Challenges and Opportunities – A Government Veterinary Services Perspective

M.A. Molomo¹ and T. Mumba²

*Ministry of Agriculture and Food Security
Department of Livestock Services
Private Bag A82, Maseru 100
Lesotho*

Animal welfare is defined as how an animal copes with conditions in an environment in which it's living. The animal is in a good state of welfare, if the animal is healthy, comfortable, well nourished, safe and is not suffering from any unpleasant situation (five freedoms). Animal welfare is a complex issue with implication on cultural, political, technical and economic levels. Trading partners are increasingly demanding healthy animals with a nice conformation and this affects the price the producers get for their animal and animal products.

Livestock keepers are also increasingly taking into consideration welfare issues because they have realized that a well treated animal yields products of better quality and quantity.

Developing countries especially in Africa have a high human and animal population, but Africa has lagged behind in controlling livestock diseases and this has affected the welfare of a lot of animals. Abuse of animals can be expressed in various ways; transportation in unsuitable condition, method of controlling stray dogs, inhuman slaughter of animals at slaughter houses and unsuitable housing for livestock. These abuses are wide spread and will have to be addressed, if the welfare of animals is to improve on the African continent.

Role of Government

Members of the OIE have agreed to implement animal welfare standards through the following:

- Preparation and enforcement of animal welfare legislation and codes of practice;
- Coordinating animal welfare enforcement agencies;
- Be the driver of collective action on animal welfare issues;
- In partnership with private sector facilitate provision of information and training;
- Develop emergency animal welfare plans.

Opportunities and Benefiting

Proper implementation of animal welfare has the following benefits:

- Access to lucrative markets in the developed countries;
- Animals that are well cared for increase productivity;
- Food safety is guaranteed with animals raised in proper sanitary conditions;
- Increased recognition of the livestock sector in the country;
- Environmental benefits.

¹ Director, Department of Livestock Services

² Head of Epidemiology and Information Section, Department of Livestock services

Constraints/ Challenges

Government agencies in most developing countries face the following challenges:

Legislation

- Lack of regulation (i.e. transport of animals, slaughter of animals, use of animal for research and education, stamping-out has to be accompanied with compensation).
- Outdated animal welfare legislation.
- Lack of strong political will.

Infrastructures

- Lack of infrastructure of any kind or old or maladjusted (Quarantine stations, housing, slaughterhouse).
- Lack of good animal husbandry and animal management practice that ensure well being of animals

Communication

- Lack of animal welfare communication strategies (to reach target groups).

Training

- Inadequately trained stakeholders on animal welfare issues (i.e. breeders, carriers, slaughter staff ...).
- Inadequate animal welfare experts to assist during trainings.
- Most agriculture school curriculum in the developing countries has not yet incorporated animal welfare subjects.

Resources

- Inadequate resources to pay for animal welfare issues which are seen as a luxury in developing countries;
- Animal welfare issues not incorporated in national strategies for livestock development.

Way forward

- Upgrade and Strengthening the legal frameworks;
- Involvement of the community (stakeholders) in animal welfare matters and strengthen the linkages between the public and private sectors;
- Build capacity on animal welfare among the veterinary officers and stakeholders;
- Networking of animal welfare actors is crucial if the standards and codes are to be implemented;
- Communication and advocacy.
- Application of Performance

Animal Welfare in Developing Countries – Constraints, Challenges and Opportunities – An International Meat Industry and Research Perspective

N G Gregory

*Royal Veterinary College
Hawkshead Lane, Hatfield, AL9 7TA
United Kingdom*

This paper examines some of the livestock welfare issues that are a feature of, but not unique to, developing countries. It focuses on the meat producing sector and discusses

- the health and welfare issues in the live animal export trade in Africa, Asia and Oceania,
- the conflict that exists between the socio-economic need for transhumance and the need for disease control internationally,
- some of the welfare problems in draught animals that are sent for slaughter at the end of their working lives,
- priorities in assisting livestock owners during natural disasters, and
- facing today's problems with livestock theft.

Working with the meat sector could be an effective way of providing incentives which achieve improvements in these areas.

Keywords: live animal export; transhumance; seasonal underfeeding; draught animals; natural disasters

International Trade

Developing countries make an important contribution to world trade in meat and livestock. They are a source of meat which is provided at competitive prices, and because of health and hygiene requirements imposed by developed countries such as the EU, the standards in slaughtering and meat processing for export can be exceptionally high. From the exporting nation's perspective, an 'export-retention balance' has to be struck between satisfying demand from overseas customers and satisfying domestic demand for meat and livestock products. This balance is influenced by currency exchange rates, which in turn is often determined by whether the developing country has natural resources such as oil and minerals which attract investment from developed countries. Resource-poor developing countries can find it more difficult to strike a suitable export-retention balance because the relatively low value of their currency favours agricultural exports.

The situation in the international livestock trade is different to that for meat. Carrying livestock as a freight is more specialised when it is by sea, and because of this it has a strong traditional element. Some of the oldest established sea trading routes in livestock are between the Horn of Africa and the Middle East, and this is a particularly lucrative trade presently. Key features which underpin the live animal export trade, whether it by sea or land, are the absence of refrigeration or freezing in the importing country, and the demand for live animals during religious festivals. For example, the export of Haryana cattle and water buffalo from India to Bangladesh hinges on the absence of meat refrigeration in Bangladesh, where the practice is to kill and consume on the same day. Refrigeration is slightly better established in Indonesia, but it is mainly present in the butcher premises, whereas refrigerated transport is not widely used for the bulk meat market. Religious festivals create annual bulges in demand for live animals, and in particular sheep, and there is mass movement of sheep to specific Asian countries.

The ways in which animal health and welfare issues associated with the live animal export trade can be approached are limited. Where it is considered appropriate to limit trade, because animal health and welfare standards are inadequate, strengthening border control points is not likely to work where land borders are extensive, or where the opportunities for

off-loading vessels are plentiful. Instead, the best longer term prospect would be to improve meat refrigeration infrastructure in the importing country with a view to reducing the demand for live animals. Where this has been tried in the past, there have been difficulties in gaining consumer acceptance for chilled in place of fresh meat, and there have also been difficulties in maintaining refrigeration equipment. Managing these failings should perhaps be priorities where further attempts focus at developing the chilled meat approach. In many developing countries presently, moving and selling chilled meat is not more convenient than moving and selling a live animal.

The live animal trade for religious festivals is not likely to stop. In the case of the haj, customers arrange for animals to be purchased and killed on their behalf, and part of the proceeds from the carcass or offal are donated to poor people. This practice is embedded in the faith and culture of the people, and an appropriate approach is to help improve animal health and welfare standards where they are deficient.

Some major international livestock trade routes

Space does not allow a description of each of the species, so the focus here will be on cattle and water buffalo. Five of the main trade routes in cattle and water buffalo are

- between Australia and Indonesia
- between India and Bangladesh
- within mainland Southeast Asia (Indochina)
- between East Africa and the Middle East
- from Brazil to Lebanon

Animal welfare standards up to the point of slaughter in the trade between Australia and Indonesia are good. This is because MLA and Livecorp have invested in infrastructure and standard-setting which promote sound and safe handling and passage. The methods used for casting and slaughter however vary substantially within Indonesia. This is not surprising, when one considers that there are about 4,000 slaughter premises in Java and Sumatra alone. Some of the standards are deficient and could be improved by demonstrating best practice. The trade between India and Bangladesh could change in the near future. Live water buffalo sourced in India are now being directed away from Bangladesh and are being presented instead as meat in more lucrative markets in the Middle East following slaughter within specialised abattoirs in India. The live Haryana cattle trade with Bangladesh is likely to continue and may even increase, to make up for the shortfall from reductions in live water buffalo numbers. The welfare issues in cattle and water buffalo arriving in Bangladesh have been well documented (Alam *et al.* 2010a, b, c and d). They are largely due to trauma connected with inappropriate transport vehicles and restraining methods, heat stress in water buffalo and metabolic depletion.

The situation in Indochina is more complex because of the extensive borders through which informal trading occurs. Regulation or inspection of the informal trade is difficult if not impossible. Important sources of cattle are Myanmar, which in turn receives animals from countries to the west. Poorer countries such as Laos PDR also make a live export contribution. The animals move largely by land to population centres in Malaysia, Thailand and Viet Nam, and there is some coastwise movement especially to Malaysia. Laos PDR and Cambodia are thoroughfares for livestock movement between countries to the west and Viet Nam. These movements have important repercussions for animal health control, and because some of the local live animal transport methods are rudimentary there are also animal welfare issues.

Cattle exported from the Horn of Africa leave mainly via Bosaso and Berbera, as do sheep and goats. The cattle mainly come from the south of Somalia and the border region with Ethiopia. Up to 3 million sheep and goats are exported per year, but in recent years it has been about half that number. There are informal entry points in Yemen, from which cattle then move in a variety of directions.

The welfare features that all these transport routes share are injuries, dehydration and metabolic depletion, and with the exception of animals leaving Australia, in recent years they have created hazards in spreading foot and mouth disease and rift valley fever.

Draught Animals

Draught animals make a modest contribution to meat supply. For example, steers from India are a staple meat source in Bangladesh, and donkeys meet some of the demand for meat in non-muslim countries such as Mexico. Trauma is the outstanding welfare feature amongst such animals at the time they are presented for slaughter. Draught animals are probably the large animal sector with the highest frequency of injuries. In addition, in some countries there is a high frequency of emaciation especially in equines, but in poor countries this does mean they are worthless as a source of meat.

Some of the injuries are avoidable. A good example is the nose injuries associated with nose ropes (Alam 2010b). Using soft ropes, and being considerate in the way the nose ropes are twisted and pulled when moving cattle and water buffalo are basic requirements of competent handling. In addition, tail injuries from tail twisting can be common in some countries. The answer to such problems is in improving awareness, and in particular in encouraging the livestock handler to raise his sense of dignity through the way he handles his animals.

Seasonal Underfeeding

As human population grows in developing countries, ruminant meat production is relegated to poorer farming regions. Livestock farming systems in poorer communities become more reliant on compensatory ('catch-up') growth. In the less sustainable farming regions, seasonal underfeeding leads to loss of body weight and condition which have to be recovered when the growing season returns. Seasonal underfeeding is a common feature in semi-arid developing countries, and one of the main ways for managing this is through transhumance.

There is a complex dilemma between veterinarians and the socio-economic need for transhumance. On the one hand some veterinarians take the position that controlling disease spread and maintaining disease-free status through boundary protection is paramount above the needs for transhumance. However, preventing the movement of animals to dry-season feeding grounds can make livestock keeping even less sustainable in some regions. Denying right-of-passage or right-to-graze untenured land is becoming a more common problem, and if the consequence is keeping livestock at home then the risk of emaciation will increase especially when coupled with natural disasters such as consecutive drought years. Keeping stock at home throughout the year can also lead to soil erosion where set stocking is practiced during the dry period, and this has been recognised as a problem in recent years in central Asia (Gregory 2007). In parts of Africa curtailment of transhumance also means that cattle are being kept in tsetse fly zones throughout the year, and so even from a disease control perspective denying transhumance can have limitations. The solutions for the veterinary-socioeconomic dilemma depend on the individual situation, but lie in either finding alternative ways of carrying stock through periods of seasonal underfeeding, promoting the off-take of livestock for meat at critical periods, or being more strategic when delineating disease control zones by allowing transhumance corridors.

Coping with Natural Disasters

Developing countries are poorly equipped to deal with natural disasters, such as floods, droughts, blizzards and locust plagues. Prompt destocking and converting the value of stock into either cash, credit or a capital resource is often the best approach to risk management during an imminent drought. However, with some people it does not always fit well with the reasons for keeping stock in the first place. Assisting realisation of the value of the animals is probably one of the most attractive approaches and the meat industry can play a key role in achieving this aim. This may be as simple as providing a small fleet of pick-up trucks which can transport freshly slaughtered carcasses to central meat depots or markets. In broad terms the overall needs during natural disasters are firstly, promoting practical approaches in surveillance of the hazard and its effects, improving awareness of the alternative responses to the hazard, and providing infrastructure enabling suitable strategies.

Theft Management

In many developing countries preventing theft has knock-on effects for livestock welfare. It creates the need for fire-branding, and for kraaling at night which can limit useful grazing time and contribute to underfeeding (Gregory 2007). In addition, in some regions it has limited the type of stock that can be farmed in a region. For example, sheep farming which

at one time used to be common throughout South Africa is now becoming concentrated in the Karoo where the risk of theft is lower.

Conclusions

The key points emerging from this paper are:-

1. The live animal export trade is likely to continue into the foreseeable future. In the present situation, moving and selling chilled meat is less convenient and less realistic than moving and selling live animals. Until standards of refrigerated transport and storage of meat improve there is little prospect of this trade diminishing. Instead, the short-term focus should be on improving the animal health and welfare standards associated with the live animal trade.
2. Transhumance is an essential feature of sustainable livestock farming in some poorer regions. It is not always compatible with disease control, and in future more attention needs to be given in animal health strategies to allowing for shortfalls in feed availability.
3. One of the ways of trying to reduce injuries in draught animals is to appeal to a sense of dignity and self-respect. Improving awareness that it is undignified and unprofessional to mistreat animals can be effective.
4. Providing infrastructure, such as carcass transport, can be a simple way of managing livestock off-take and assisting livestock owners during seasonal underfeeding or during an imminent natural disaster such as a drought.

Many of these improvements can be implemented through or with the assistance of the meat sector.

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Animal Welfare in Developing Countries – Constraints, Challenges and Opportunities – Experience with Stray Dog Control and Rabies

Natasha Lee

*Companion Animals & Tertiary Animal Welfare Education, WSPA Asia
19th Floor Olympia Thai Tower, 444 Ratchadaphisek Rd
Samsennok, Huay Kwang, Bangkok 10320
Thailand*

Millions of stray dogs roam our streets and are a visible concern in almost every country of the world. Many of these ‘strays’ may actually be owned whilst allowed to roam, many others have some form of a caretaker in the local community, but despite this limited care many suffer from disease, malnutrition, fights, road traffic accidents and abuse from people who do not tolerate their presence. Even more concerning is the various measures put in place to control these stray dogs, even with the best intentions, which can inflict suffering. The mass killing of dogs is commonplace in Asia, as are overcrowded shelters and ill-targeted ‘catch-neuter’ programmes used as a single response, all of which fail to address the root causes of stray dog populations and the problems they pose.

The management of dog populations is necessary for the protection of human as well as dog welfare - dogs are the vector for more than 98% of human rabies deaths in Asia and also threaten human health through dog bites and road accidents. The challenge is how governments, NGOs, the community and other stakeholders can work together to manage dog populations in a way that satisfies their various different concerns and does not cause animal suffering. Opportunities arise when inter-governmental organisations such as the World Animal Health Organisation (OIE) or the Association of South East Asian Nations (ASEAN) recognise the importance of animal welfare in designing an intervention for dog population or rabies control.

There is no single solution that will work for all situations. To design the most effective and resource-efficient approach, the following questions need to be answered for the specific location: What is the size of the total dog population and the categories within it (e.g. owned, unowned, confined, roaming)? What are the sources of dogs (e.g. abandonment, lost, allowed to roam, born stray)? What are the problems (real or perceived) caused by the dog population? What welfare problems do the dogs face? Who are the stakeholders and what are their motivations for controlling stray dogs? Do people want dogs on the street? What is currently being done? How the answers to these questions can be used to design an effective and humane dog population management programme suitable for a specific location will be discussed, using examples from Asia.

International Developments Relating to the Use of Animals in Science

Judy MacArthur Clark
Animals Scientific Procedures Inspectorate
Home Office, 2 Marsham Street
London SW1P 4DF
United Kingdom

The use of animals in science is an emotive subject attracting much public concern. Over the last 25 years, scientifically advanced nations throughout the world have been developing systems to regulate the use of animals in research and teaching. These are based on three guiding principles: the implementation of a **Harm-Benefit Analysis** during ethical review of project proposals; full consideration and application of **the Three Rs**; and balancing the needs of science and animal welfare to deliver public confidence - both that science will not be inhibited from discovering much needed solutions to global problems and that animals will be appropriately protected. Balancing these elements is the third guiding principle, often referred to as **The Regulatory Balance**.

Significantly for countries emerging in science, a new chapter in the OIE (World Organisation for Animal Health) Terrestrial Code entitled Use of Animals in Research and Teaching has been published (OIE, 2010). This chapter describes the regulatory framework in a very flexible framework incorporating these guiding principles.

Other recent initiatives which support this framework include: the alignment of specialist colleges of laboratory animal medicine into an international association (IACLAM); the development of global standards for veterinary training in this field; the development of an International Primate Plan to embrace the global sourcing and use of primates in research; the efforts of VICH (Veterinary International Co-operation for Harmonisation) to implement the Three Rs in veterinary regulatory testing; and the accreditation of international standards of animal care through AAALAC (the Association for the Assessment and Accreditation of Laboratory Animal Care International).

This paper considers the consequences of these initiatives for nations ambitious to establish a reputation in science and technology. Training of veterinarians in laboratory animal medicine is critically important and the profession, globally, must take this responsibility enthusiastically to heart.

Keywords: animal welfare; laboratory animals; science and research; primate; three Rs; harm-benefit analysis; regulatory balance;

Introduction

“The greatness of a nation can be judged by the way we treat our animals”.

Mahatma Gandhi (1869-1948)

Animals have been used in scientific research for over two thousand years. We know that Claude Galen (129-199 AD), a physician and philosopher in Ancient Greece, practised vivisection on pigs and goats as part of his study of science (Frampton, 2008). Of course, there was no anaesthesia at this time so some of his experiments must have been rather gruesome.

In the seventeenth century, René Descartes (1596-1650) propounded his view that only humans had consciences, and that animals were mere machines, incapable of feeling pain (Garner, 1993). This led to a plethora of vivisection experiments across Europe over the next 100 years until Jeremy Bentham (1764-1825) assigned a moral status to animals. In a memorable statement in 1789, he put forward the then radical view that “The question is not can they reason, nor can they talk, but can they suffer?” (Bentham, 1823). This has largely been the foundation for our current utilitarian view in which the harms caused to an animal in a scientific project must be balanced against the benefits which are predicted to accrue. Ideally, the potential benefits should outweigh the harms in a “Harm-Benefit Analysis”.

With the discovery of a number of anaesthetic agents (e.g. nitrous oxide, ether and chloroform) in the 1840s, anaesthesia

became part of medical treatment for humans. The UK Cruelty to Animals Act of 1876 was designed to control the ‘vivisection’ of animals – strictly speaking defined as the cutting up of animals whilst alive – by determining the conditions under which animals must be anaesthetised, with or without recovery. However no justification for the use of animals was required.

During the twentieth century, two major events occurred. The first was the UFAW (Universities Federation for Animal Welfare) publication in 1959 of “The Principles of Humane Experimental Technique” by William Russell and Rex Burch, both UFAW research fellows (Russell & Burch, 1959). This seminal work first outlined the Three Rs, still abiding principles in the use of animals in research.

Replacement	
o	Using cells, tissues, organs of animals e.g. <i>in vitro</i> (relative replacement)
o	Using totally non-animal methods, e.g. <i>in silico</i> (absolute replacement)
Reduction	
o	Using fewer animals, often through good experimental design
Refinement	
o	Using methods which minimise pain or distress
o	Using species with less capacity to feel pain

Table I. A brief definition of the Three Rs of Russell & Burch.

Secondly, in 1975 Peter Singer published “Animal Liberation” which rapidly became the ‘gospel’ for the newly emerging animal rights movement (Singer, 1975). Singer coined the term ‘speciesism’ which advocated that humans and animals should be considered equal. However Singer also supported a utilitarian approach which dictated that, in any animal research, the harms caused to the animals must be outweighed by the benefits to humans or animals. This “Harm-Benefit Analysis”, and the ethical evaluation essential to its effective implementation, have formed the cornerstone for most regulatory developments in this field ever since.

The status of modern regulation

During the late twentieth century, most scientifically advanced nations implemented regulations to control the use of animals in research. A number of these, and their more recent updates, are listed in Table II.

UK – Cruelty to Animals Act 1876	
o	Followed by Animals (Scientific Procedures) Act 1986
o	Currently being updated for 2012
Europe – Directive 86/609 for the protection of animals used for scientific purposes 1986	
o	Revised in 2010
USA – Laboratory Animal Welfare Act 1966	
o	Updated in 1989
o	8 th edition of the ILAR “Guide” published in 2010 – being translated into multiple languages
Australia – Animal Research Act 1985	
o	Regulations last updated in 2010
New Zealand – Animal Welfare Act 1999	
o	Currently under review

Table II. Examples of legislative moves to regulate the welfare and use of animals in research internationally.

In all these regulatory developments across the world, the trend has been away from the somewhat Victorian concept of the 1876 UK Act of avoiding cruelty, and more towards the ‘duty of care’ placed upon scientists to both justify their work

and to ensure it is done to the highest standards of animal welfare. An ILAR international workshop in 2003 reviewed the evidence for science based guidelines for laboratory animal care and made a number of recommendations for further research (NRC, 2004). It is interesting that accurate figures for the use of animals in research are not available in many countries. An estimate of global usage per annum is provided in Table III with a comparison to an estimate of mammalian animals killed annually for human consumption (Pickering, 1992).

Estimated numbers of animals used in research:	
• USA	17 - 22 million ⁺
• Europe	10 - 12 million (UK 3.5 million)
• Australia	~ 5 million
• Rest of the World	~ 20 million
• Total	~ 60 million (mainly vertebrates)

US official figures exclude rodents and birds, estimated here to be about 90% of use

Estimated numbers of animals slaughtered for meat:	
• Total	~ 1.75 billion (cattle, sheep, goats & pigs)

Table III. Estimates of annual global use of animals in research compared with food production.

The Three Guiding Principles

i. Harm Benefit Analysis

It is important that a **harm-benefit analysis** is performed on a case by case basis as an ethical review of proposed research projects. Typically this is performed either by a government “Competent Authority” at a national level (as is the case in the UK) or at a regional level (as in many other EU Member States) or, in the USA, it is performed by in-house committees (IACUCs – Institutional Animal Care and Use Committees). In all cases, there is a significant role for veterinarians in this review, especially in performing the project assessments and effectively reducing harms. It may also be important to have scientific and independent lay opinion – the former to assess the scientific rigour of proposals, and the latter to provide a perspective on behalf of the public.

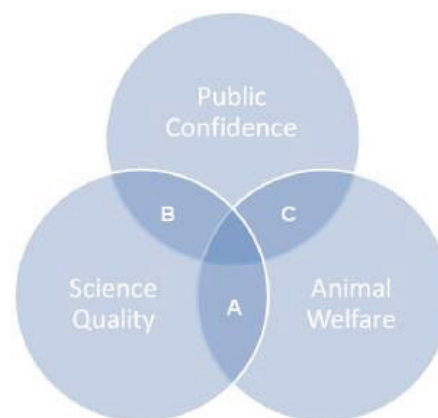
ii. The Three Rs – Replacement, Reduction, Refinement

Benefits can often be difficult to predict, especially in basic research, but all **the three Rs** (Replacement, Reduction and Refinement – see earlier) should be assiduously applied to reduce the costs (harms) to the animals as much as possible. Once the project has started, it is important to continue monitoring the impact on the animals and to grasp any new opportunities to implement the Three Rs. This is often referred to as post-approval monitoring.

iii. The Regulatory Balance

The third guiding principle, the **regulatory balance**, is often illustrated as a Venn diagram of three overlapping circles (Figure I). In any regulatory system, it is essential to ensure that bureaucracy and rules do not become so burdensome as to inhibit scientists from developing good quality scientific proposals which will address important research questions. However it is also important to ensure that animals will not suffer unnecessarily in such research projects. Thus there needs to be a balance between the needs of the science and the needs of the animals. Furthermore, there is strong evidence to show that good animal welfare leads to good scientific outcomes (the overlapping area A).

It is this balance between science and welfare which provides the public with confidence in the regulatory system. The public wants to benefit from scientific advances, but also wants to be reassured that animals are not suffering unnecessarily (the overlapping areas B & C). The nature of this balance will differ between different countries taking into consideration their diverse cultural,



economic, religious and social factors. However the guiding principle of the Regulatory Balance can be fruitfully applied in any country in determining an appropriate approach to regulation of animal use in research.

Developing a Regulatory System

For a country developing a new regulatory system, where should you start? There is no doubt animal research is a complex area. But Science & Technology is likely to be critical to future success and wealth of all nations and, as part of that success, animal research will play an important role for the foreseeable future. In addition, animals will be used to a limited extent in the training of the next generation of research scientists. However, there is significant reputational risk for a country with poor or non-existent regulation of animal research, and therefore many universities and major corporations based in scientifically mature countries will only place studies in countries with appropriate regulations. Effective regulation of the use of animals in research and education is therefore critically important for all countries.

It was with this in mind that the OIE established an expert working group in 2007 to develop a framework suitable for all countries for regulating animal research. Chapter 7.8 in the OIE Terrestrial Code entitled The Use of Animals in Research and Education provides that framework in the form of a template with flexibility for diverse cultural, social, economic and religious factors (OIE, 2010). OIE has 178 member countries and territories and it is intended that this template will find application throughout that global structure.

The Role of Veterinarians

Veterinarians play an especially important role in ensuring the appropriate use of animals in research. Table IV summarises the range of important tasks which can be readily fulfilled by appropriately trained veterinarians. Zurlo, Bayne and MacArthur Clark have reviewed the provision of such veterinary care from an international perspective (Zurlo et al, 2009).

Care, health and welfare of animals
o Clinical health, post mortems, medical records
Advice or experimental techniques
o Surgery and post operative care
o Anaesthesia, analgesia and euthanasia
o Humane end-points
Participate in ethical review processes
o Especially in relation to refinement
Inspection and project assessment & authorisation
o Ideally qualified for both these functions
Training of scientists and animal care staff
o Research and husbandry procedures
o Environmental enrichment
Biosecurity
o Avoid infection of animals and humans

Table IV. Tasks which may be fulfilled by appropriately trained veterinarians.

Currently the basic training of veterinarians in most, if not all, countries is not adequate to enable them to completely fulfil this role without further training. Specialist veterinarians are recognised internationally as “Diplomates” of Colleges of Laboratory Animal Medicine (four colleges currently exist: ACLAM – the American College; ECLAM – the European College; JCLAM – the Japanese College; and KCLAM – the Korean College) and these colleges have been united since 2005 as an International Association of Colleges of Laboratory Animal Medicine (IACLAM). Together with ILAR and OIE, IACLAM is preparing guidance for post-qualification training of veterinarians in laboratory animal medicine which is due to be published in the ILAR e-Journal in 2011.

The colleges also liaise with national and regional associations of veterinarians who have an interest in laboratory animal medicine but have not achieved specialist status. These include the Association of Laboratory Animal Practitioners (ASLAP) in North America, the European Society of Laboratory Animal Veterinarians (ESLAV) in Europe, and the Asian Federation for Laboratory Animal Science (AFLAS) which has a veterinary caucus in Asia.

Other international initiatives

Finally, it is important to mention a number of other international initiatives as they relate to developments in this field.

Firstly, it is widely recognised that the use of nonhuman primates in research will be essential for the foreseeable future but there is great concern globally about sustaining the availability of quality animals for research. There is no global overview of nonhuman primate resources and prioritisation for their use and there is poor sharing of information between countries with active research programmes. The countries which are breeding primates are also emerging scientifically and wish to become active in research as well as production of these species. They might benefit from advice and mentorship from individuals in those countries with more experience in this field. And there are a number of issues relating to the transport, welfare and conservation of these species which need to be considered globally.

Against this background, ILAR is about to commence work on developing an International Primate Plan to address these many issues. It is intended that, through a committee of international experts (including from source countries), ILAR will develop recommendations which will:

- **Preserve & develop this essential resource for the future of human health;**
 - o to influence global policy and funding decisions;
- **Ensure appropriate care and use of nonhuman primates;**
 - o e.g. welfare standards, training, implementation of the Three Rs, etc.;
- **Provide detailed characterisation of nonhuman primates;**
 - o to aid interpretation of data & reproducibility of results;
- **Establish a sustainable international informatics network;**
 - o to enable sharing of information and resources, and to promote global collaboration;
- **Impact positively on the development of research using nonhuman primates in emerging countries.**

A second important initiative is the extension beyond North America of AAALAC International (the Association for Assessment and Accreditation of Laboratory Animal Care) as an accrediting organisation. AAALAC is a private, non-profit organisation which promotes the humane treatment of animals in science through voluntary accreditation and assessment programmes. AAALAC has been accrediting animal care and use programmes for over fifty years and more than 800 companies, universities, hospitals, government agencies and other research institutions in 34 countries have now earned AAALAC accreditation. These institutions have volunteered to participate in AAALAC's programme in addition to complying with any local, regional and national laws that regulate animal research.

Applicant organisations must prepare a programme description which includes details of their animal care and use programme management and oversight, the environment in which animals are housed and used (including the physical plant) and a description of the veterinary care provided. A team made up of two or more AAALAC representatives will then visit the site by appointment and review the details of the programme description, meeting the key individuals involved. Accreditation may be awarded either outright or subject to a small number of mandatory items which must be corrected. Alternatively, provisional accreditation may be granted giving up to 24 months to meet the requirements for full accreditation. Finally, accreditation may be withheld. In order to maintain their accreditation, organisations must provide an annual written report to AAALAC as well as receiving a re-accreditation visit every three years. If in doubt about the feasibility of achieving accreditation, applicants can opt for a Programme Status Evaluation which serves as a pre-accreditation visit. Details of

AAALAC's accreditation programme can be found on their website (www.aaalac.org).

For many research organisations in scientifically emerging countries, AAALAC provides an important and independent audit process with quality assurance of their animal care and use programme. This can be useful in demonstrating the standards to which they constantly aspire as well as giving assurance to potential overseas collaborators.

A third important initiative of relevance is the VICH (Veterinary International Co-operation for Harmonisation). VICH is a trilateral (EU-Japan-USA) programme aimed at harmonising the technical requirements for veterinary product registration. Launched in 1966, VICH has published a number of guidelines which meet high quality, safety and efficacy standards whilst minimising the use of animals. More recently, VICH has been keen to engage with non-VICH countries to better understand their needs and expectations (VICH, 2010).

Conclusions

In conclusion, it is clear that developing effective skills in Science & Technology will be key to the success and wealth of all nations in the future and that animal research will play an essential role in that success. There are a number of critical functions for well trained veterinarians to fulfil in this success.

Our view of the moral status of animals used in research has changed over the last hundred or so years and this is reflected now in a focus on our "duty of care", as opposed to simply avoiding cruelty. This leads us to three guiding principles in the modern day practice of research using animals.

- Any scientific research or teaching project must be ethically evaluated and justified in a **harm benefit analysis**;
- the **three Rs** of Replacement, Reduction and Refinement must be effectively applied at all times, both before and during the course of any research or teaching project; and
- a **regulatory balance** must be achieved to ensure regulation is both proportionate and promotes public confidence.

These principles are reflected in the words of one of the Commonwealth's greatest citizens, Mahatma Gandhi, from whom we learnt that "The greatness of a nation can be judged by the way we treat our animals".

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Better Training for Safer Food: International Training Programmes on Animal Welfare

Barbara Allesandrini

*OIE Collaborating Centre for Veterinary Training, Epidemiology, Food Safety and Animal Welfare
Istituto G. Caporale, Teramo-I
Italy*

In 2007, Istituto “G. Caporale” became animal welfare training service provider of the European Commission in the framework of the “Better Training for Safer Food” (BTSF) programme. Since then to 2012, it will have provided 17 European training courses to about 1,000 official veterinarians from both member and third countries. The BTSF programme is dedicated to all staff of competent authorities of Member States involved in official control activities but it is also opened to third country participation. Courses on animal welfare are followed in particular by official veterinarians from Countries of the Mediterranean basin, North and South America and Oceania, having some of them specific bilateral trade agreements with EC. Animal welfare issues are dealt in whole animal life cycle, from breeding to slaughter and killing in depopulation situations. In the quest of being competitive in the European framework and of trying to satisfy its customs in terms of training quality, courses are delivered using a validated training management system, based on ISO 9001:2000 norms.

The continuous improvement of the organisation efficiency and effectiveness is due to a constant pursuit of innovation related to both methods and technology, as well as for technical-scientific excellence of the educational content.

New animal welfare learning pathways are investigated to better respond to learning needs of beneficiaries (participants) and of member countries (authorities), while new delivery solutions are used to strengthen and empower a worldwide network of expertise, to compare different EU centred approaches and integrate them with the OIE and FAO perspective, to develop new curricula, to spread knowledge and competences.

Different practicable solutions are adopted to enhance knowledge spreading and expertise sharing not only at European level, but worldwide. Traditional methods such as training courses, workshops, seminars, conferences, in fact, represent a unique opportunity for networking and solution sharing, but they show also a number of undeniable weaknesses that have to be taken into account when a massive approach has to be adopted. For this reason, a combined approach to training solutions probably represents the most appropriate strategy, in which different “classical” and modern methodologies are blended.

Lessons Learned from the Development of a Regional Animal Welfare Strategy for the Asia, Far East and Oceania OIE Region

Peter Thornber

*Australian Animal Welfare Strategy
Australian Government Department of Agriculture, Fisheries & Forestry
GPO Box 858, Canberra ACT 2601
Australia*

Australia finalised an Australian Animal Welfare Strategy (AAWS) in 2004 and the Australian Government is providing leadership, coordination and approximately one million Australian dollars annually to support implementation of this national Strategy.

The livestock export Industry is a controversial but important trade for Australia, generating approximately one billion Australian dollars annually and providing more than 10,000 jobs in regional Australia. The Australian Government and livestock industries have invested many millions of dollars to improve handling infrastructure, transport and slaughter of animals in Middle East countries that will benefit the welfare of local animals, not just imported Australian animals.

Australia worked with the Middle East Gulf Cooperation Council to assist in developing a regional animal welfare strategy for the Middle East in 2005-06 based on the broad approach of the AAWS. Under this Strategy, Australia provided technical assistance to the United Arab Emirates to write their animal welfare regulations for their Animal Welfare Law. Further support was provided to train animal welfare inspectors.

The Australian Government has provided similar leadership and funding to engage countries of the World Organisation for Animal Health (OIE) Regional Commission for Asia, The Far East and Oceania as part of supporting trade interests and strategic relationships, and technical cooperation. This first OIE regional strategy was endorsed by 176 OIE countries as a model for other regions. It provides a platform to engage the complete spectrum of animal welfare stakeholders. By having broad goals, governments, welfare organisations, professional groups, livestock industries and donors can all contribute to its successful implementation.

OIE has also endorsed an implementation plan for the Strategy and Australia and New Zealand is continuing to provide expertise and some support funding to assist. Australia is providing secretariat support and an implementation coordinating group has been formed. Membership is drawn from regional countries, the World Society for the Protection of Animals (WSPA) and a representative from Australia's livestock export Industry that is providing funding to improve livestock handling and slaughter infrastructure and trainers to improve skills and expertise.

Keywords: OIE; Regional animal welfare strategy; Australian Animal Welfare Strategy; Asia, The Far East and Oceania

Introduction

Animal welfare is a complex and sometimes, divisive issue and individuals base their opinion on inherent values, beliefs, moral and ethical views, religion and socio-economic circumstances. However, it has become a big global issue with a strong focus on the treatment of farm animals within the food chain.

Animal activists are clearly running more campaigns and gaining media attention and the internet and social media networks mean that issues in one country rapidly become world news. There is also increasing demand in some global markets for 'animal welfare friendly' products. This poses some threats to traditional farming approaches but offers some new marketing opportunities as well. The issue is how will the increased costs of producing meat, eggs and fibre in less intensive systems flow back to the producers. There needs to be financial incentives and fairness at the farm level and this does not exist in many countries.

The Australian Government Department of Agriculture, Fisheries and Forestry (DAFF) developed the Australian Animal

Welfare Strategy (AAWS) in 2003, with the assistance of the National Consultative Committee on Animal Welfare (1). A high level Advisory Committee was appointed and a national implementation plan (NIP) developed with some 120 diverse stakeholders in 2005. Sectoral and cross-sectoral working groups were established and a gap analysis informed foundation priority work conducted between 2005 and 2009.

Australian Animal Welfare Strategy: An International Model

In Australia the welfare of animals is protected through legislation administered by each of the state and territory governments. Some industries provide an additional level of animal welfare protection through quality assurance programs. The Australian Government does not have legislative responsibility but plays a leadership and coordination role with the aim of enhancing national consistency in legislation and outcome, and reducing duplication of effort to increase efficiency in public expenditures. It also acknowledges the importance of broad engagement with industry, governments, professional associations, researchers and welfare organisations for a range of perspectives, to accurately assess current and merging issues and priorities, and to develop robust solutions.

The strategy covers all Australian animals and all segments of the community, so the range of issues that need to be considered and actioned is very broad. Six sectors of animal use or management have been identified. Each has an assigned working group that involves a range of stakeholders to identify, prioritise and manage activities. The six working groups are:

- Animals used in research and teaching;
- Livestock and production animals;
- Companion animals;
- Aquatic animals;
- Animals used for recreation, entertainment, display and work; and
- Native, introduced and feral animals.

There are also issues that cross the boundaries of the animal sectors and require specific attention and investment. Three working groups have been established to address these areas; research and development, education and training, and communication.

Assisting a Regional Plan for the Middle East

The livestock export Industry is a controversial but important trade for Australia, generating approximately one billion Australian dollars annually and providing more than 10,000 jobs in regional Australia (2). The Australian Government and livestock industries have invested many millions of dollars to improve handling infrastructure, transport and slaughter of animals in Middle East countries that will benefit the welfare of local animals, not just imported Australian animals. Following an external review of the livestock export trade in Australia in 2003 a number of legislative and other changes were made to improve animal welfare outcomes. In particular, there was increased effort to improve post-arrival handling of Australian livestock in destination countries in the Middle East and South East Asia.

Using the AAWS as a model and framework, Australia sponsored a number of high level workshops with the Gulf Cooperation Council countries of Saudi, Qatar, Oman, United Arab Emirates, Kuwait and Bahrain. A regional plan to improve animal welfare transport and handling was developed in 2006.

Taking the AAWS to Asia/Oceania

This approach was then used in South East Asia to engage the countries in the OIE Regional Commission for Asia, The Far East and Oceania, assisted by New Zealand. Australia has a significant trade in live cattle to Indonesia and other countries in the region. Australia engaged OIE members and also included livestock industry representatives, World Society for the Protection of Animals and other key groups.

Agreement on a long-term broad vision

The Australian strategy has a vision statement, *'that all Australians value animals and are committed to improving their welfare', and a new mission 'to achieve sustainable improvements in welfare for all animals'.*

Having such a very broad vision, opens up the door for engaging people with different animal welfare views to engage in the process. It is important to find common ground for all stakeholders.

The vision for Asia/Oceania is *'a region where the welfare of animals is respected, promoted and incrementally advanced, simultaneously with the pursuit of progress and socioeconomic development'.*

This region represents an estimated two thirds of the world's population with very diverse races, religions and politics (see Figure 1). There is an enormous and growing livestock population in Asia, the Far East and Oceania. A large number of these are draft and working animals but most of those animals will eventually be slaughtered for human consumption. FAO 2008 statistics estimate total livestock slaughterings, excluding poultry, across all of Asia to be in the vicinity of 1.4 billion animals. Of these, around 1.3 billion were slaughtered in East, South-East and Southern Asia¹. Animal welfare concerns exist about these matters.



Establishing a framework for engagement

Australian used the OIE Regional Commission for Asia, The Far East and Oceania as a vehicle to engage countries about the concept of having a regional animal welfare strategy and the potential benefits. The OIE has developed broad guidelines for animal welfare and international animal welfare standards (3). It also has international programs on capacity building to implement the OIE welfare guidelines.

Countries agreed on the following four broad goals (4):

1. Promotion and achievement of a high level of understanding and awareness of animal welfare in the region through effective coordination, communication, education and training.
2. Ensuring a coordinated regional approach and ongoing commitment to the implementation of OIE animal welfare standards and guidelines.
3. Achievement of sustainable improvements in animal welfare based on regional and international research and development.
4. Development of sustainable mechanisms to coordinate and promote animal welfare programs and priorities.

The following approach and timetable was used:

- Regional Animal Welfare Workshop (Nov 2007)
- Writing Group established (Feb 2008)
- Strategy endorsed (May 2008)
- Implementation plan endorsed (Nov 2009)

¹ SOURCE: Searches performed on 10 June 2010 through FAOSTAT, the online statistical database of the United Nations' Food and Agriculture Organisation at <http://faostat.fao.org/site/569/default.aspx#ancor>

- Implementation workshop (*April 2010*)
- Coordinating Group formed (*April 2011*)

The Australian Government provided funding to support meeting representatives from governments and selected international non-government organisations. The governments of Australia and New Zealand subsequently provided additional funding to the OIE Global Fund to assist with implementation. Australia continues to provide secretariat support to the program.

Considerations and issues

The development of the broad vision and goals raised important ‘people’ issues that need to be considered, particularly in the implementation plan

- Culture
- Religion
- Socio-economic situation, and
- Values.

Based on these issues, each country will have different priorities. It is up to each country to decide which goal, objective and activities to implement first. Farmers, villages, communities, livestock industries, exporters and businesses must ‘own it’ and see the benefits, including in marketing and trade. It is also important to acknowledge that delivery of the goals and objectives is long term (20 years or more) but short-term benefits and impacts can certainly be achieved and need to be demonstrated and communicated to maintain support for the program.

The concept of program logic has been used widely in natural resource management (5). You plant a tree but don’t see the full benefits for 20 years. Australia has applied this approach to its revised Australian Animal Welfare Strategy 2010-14 and it is a relevant approach to use in animal health and welfare planning.

In setting agreed priorities, each country needs to develop its own national animal welfare strategy, based on the regional strategy and implementation plan. There will also be a need to deal with particular priorities e.g. emergency animal management from disease epidemics, natural disasters. This process should be led by the national governments of each country to ensure the necessary political support, including the availability of resources and funding.

To implement an ambitious regional program as outlined, a business framework must be established. This requires dedicated funding, leadership, regional coordination and country coordination. This means establishing a management structure at the regional and national levels with dedicated working groups that can ensure cohesion, share expertise and assist with political support. OIE has established a network of country ‘focal points’ so that there is a dedicated government officer in each country to be the point of contact for information exchange and advice.

Efficiency in capacity building efforts

There are many government and non-government agencies working and investing in capacity building in developing economies. In many cases, they are working independently and all have different and often comprehensive requirements to report on outcomes from donor funds. This can create a significant burden on the government staff in these countries who are dealing with multiple political issues as well as serious disease epidemics and natural disasters. It can create ‘donor fatigue’.

Having a single regional plan can significantly ease this problem as donors can be engaged to provide funds to assist with regionally and nationally agreed priorities. By coordinating donors to work together from the same plan, efficiencies at many levels can be achieved. It also makes it easier to report on progress and milestones. Working together provides new networks and opportunities and makes expertise more broadly available.

Evaluation approaches in the animal health sector may also be relevant in the animal welfare area. For example, the

OIE Performance of Veterinary Services (PVS) tool which assists in identifying priorities, gaps, is a sound framework to adapt for evaluating animal welfare needs and targets to build capacity (6). OIE has included animal welfare in this system. The United Nations Food and Agriculture Organisation is similarly focused on capacity building (7) and has many useful tools and programs to also assist.

Conclusion

Having a regional animal welfare strategy is an efficient and cost effective approach to engage governments, animal owners and users and the community. It is a platform for engagement of people with varying views about animal welfare by creating a 'shared vision' and broad goals and objectives.

Any plan to improve animal health or welfare needs to be 'owned' rather than imposed. This requires extensive consultation and the importance of having a communication strategy cannot be underestimated. This consultation and communication plan needs to promote the benefits of improving animal welfare outcomes as a central message. The process is one of evolution, not revolution and delivery of the broad vision and goals will take 20 years or more. However, there can be significant short term outcomes and benefits and these need to be promoted and reported to donors, governments and other stakeholders to maintain interest and support.

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Session 2: The Future of Livestock in Africa

Global update on Newcastle Disease and Current Advances in Research

Ian Brown

*Veterinary Laboratories Agency (VLA)
Weybridge
United Kingdom*

Newcastle disease is one of the most important infections of poultry worldwide. During the last 15 years in excess of 110 countries have reported either sporadic or ongoing outbreaks with avian paramyxovirus type 1. The impact of NDV on the small backyard poultry sector can be significant, affecting the availability of animal protein with such reliance on poultry species. The avian paramyxovirus type 1 family is genetically and antigenically diverse and continues to evolve. The emergence and changing patterns of disease continue to provide challenges to both the commercial and non commercial sectors. The virus can exist in many forms, from avirulent to viscerotropic, the latter producing a high lethality in affected species. The virus can be maintained in a virulent form in wild bird populations or can exist as an avirulent phenotype mutating to virulence upon introduction into poultry populations, thereby the number of risk pathways for introduction of virus are variable and will depend on region, production type and presence of flock immunity. APMV-1s are now maintained independently in Columbiformes (pigeons and doves) around the world and these present a continuing ongoing threat to domestic poultry. Prophylactic vaccination is widely practiced around the world and is a major contributor to reduction of disease burden where applied using fully efficacious vaccines in an appropriate manner, the incursion of infection can be significantly minimised. However, vaccinated populations are not fully protected against infection and virus can still circulate, thereby presenting a source of virus of greater risk to non vaccinated populations. Current information on the variability of the virus, it's global distribution and current control options will be presented.

The Potential of East Coast Fever (ECF) Vaccine on Improved and Indigenous Cattle in Tanzania

Magwisha H.B¹, Ruheta M.R², Mbwambo H.A¹, Madege M³, Ranga E.E³ and Makungu L.S³

Central Veterinary Laboratory (CVL)
Department of Parasitology, P.O Box 9254, Dar es Salaam
Tanzania

A study was conducted to determine the protection ability of East Coast fever (ECF) vaccine delivered in several regions of Tanzania. A total of 1216 immunised cattle were sampled from four regions of Tanzania for analysis of *Theileria parva* antibody levels. Animals that were examined came from Arusha region (225 cattle), Coast region (208), Mara region (311), and Morogoro region (472). In addition, there were 29 and 38 controls from Coast and Morogoro regions, respectively. Blood sample was taken from jugular vein into plain vacutainer tubes. The sera were analysed using an indirect ELISA test. The cut off point for ECF antibody titre was titrated to be e² 20 percent positivity (PP). Results show that the efficacy of the vaccine was 70% whereas 46% of non-immunised controls were also protected. Cattle with e² 20 PP were Arusha 72 (32%), Coast 151 (73%), Morogoro 375 (79%), and Mara region 255 (82%). The protection percentages were comparable for Morogoro and Mara, which were significantly higher when compared to Coast and Arusha (p<0.01). The mean PP differed among the regions when compared to each other (p<0.001). The animal age and time span after immunization did not significantly influence the mean PP (p>0.05). The sero-prevalences of other tick-borne diseases were conducted for samples from Arusha only and were as follows: *Babesia bigemina* (24%), *Anaplasma marginale* (19%), *Cowdria ruminantium* (11%) and *Babesia bovis* (0.4%). These results demonstrate that ECF immunized cattle would confer different level of immunity probably owing to geographical location, tick challenge, frequency of acaricide application and/or management system. It is concluded that ITM is a potential control method of ECF and that the prevalence of other TBDs could be higher than previously thought especially so for the *C. ruminantium*.

Key words: Antibody level; East Coast fever (ECF); Immunisation (ITM); Muguga cocktail vaccine; Tanzania; *Theileria parva*;

Introduction

Immunised cattle against East Coast fever (ECF) are known to carry long-standing protective immunity (Morzaria et al., 1987). However, acquisition of immunity through natural infections seems to be uncertain and expensive following repeated treatments. In fact, calves tend to go down with the disease two to three times in order to become immune. The cost of treating an advanced case using bupavaquone is expensive because may need two to three doses or a combination of antitheilerial and a diuretic agent (Mbwambo et al., 2006). For example, in the study conducted by Mbwambo et al. (2006) 44% of naturally infected cattle required more than one treatment. Again, some antitheilerial drugs such as, halofuginone tend to result into recrudescence (Dollan, 1986). In the worst cases 45% of treated cases were reported to die of the disease (Njau et al., 1985). Immunisation may reduce the severity of the disease in case it occurs. For instance, Morzaria et al. (1988) reported 50/80 (62.5%) severe cases in un-immunised cattle. Conversely, they noted 3/80 (4.8%) severe cases in immunized cattle.

Tick-borne diseases (TBD) could be controlled by the conventional method, acaricide application, but again the high cost of acaricide, the low number of operational dips, and seasonal availability of water may jeopardize the potential of this option. Of the available 2015 dip tanks in Tanzania it is only 623 dips that are in good condition, and 50% of those are operational. On the other hand, infection and treatment method (ITM) for the control of the disease have been in place since late 1980s. To date over 250,000 both improved and indigenous cattle have been immunized against ECF in Tanzania (MLD reports). The approved vaccine (Muguga cocktail) constitutes three strains, Kiambu 5, Muguga and Serengeti transformed, which are believed to contain all virulent ECF serotypes found in the Central, Eastern and Southern African region. The vaccine was formally produced and supplied by the International Livestock Research Institute (ILRI), Nairobi, Kenya. In the recent

1 Central Veterinary Laboratory (CVL), Department of Parasitology P O Box 9254 Dar es Salaam, Tanzania

2 Ministry of Livestock Development and Fisheries (MLDF) P O Box 9152 Dar es Salaam, Tanzania

3 Veterinary Investigation Centre P O Box 129 Mwanza, Tanzania

past the production was transferred to the Centre for Ticks and Tick-borne Disease Control (CTTBD), Lilongwe, Malawi.

A logical criterion for the evaluation of any vaccination programme is the prevention of morbidity and mortality. A more subtle but equally important criterion is the evaluation of production parameters. However, production can also be affected by numerous environmental and management parameters. Invariably vaccination programmes require faultlessness. Therefore, a vaccination programme is incomplete if it does not include regular serologic monitoring. The monitoring of immunity resulting from vaccination or disease challenge typically depends on the detection of antibodies in the blood, which are produced by humoral response. It was therefore the purpose of this study to establish the baseline antibody titers that resulted from vaccination in different geographical location and management systems of cattle in Tanzania in order to make recommendations on the incorporation of ITM in the integrated ECF and other TBD control in endemic areas.

Materials and Methods

Study area and target animals

Four regions that had previously, a year ago, immunized their cattle against ECF were included in this study. These regions include: Arusha (Arumeru and Arusha urban districts), Mara (Tarime and Musoma districts), Morogoro (Kilosa and Mvomero districts), and Coast (Bagamoyo district).

Sampling

Before taking jugular blood from cattle for serology, a few randomly selected farmers were interviewed. A semi-structured questionnaire was used to interview the farmers on the effect of ECF immunisation. Farmers were interviewed about morbidity and mortality owing to ECF and other TBD, the growth performance of immunised animals, and frequency of acaricide application in their herds.

Animals that were sampled included indigenous and improved herds that were immunized using FAO- ECF vaccine, Batch No: 2 (FAO₂) between March 2004 and September 2004. The age of the immunised animals ranged from five months to over four years. Immunised animals were blood sampled randomly. The blood was collected from jugular vein into plain vacutainer tubes (Belliver Industrial Estate, UK). A total of 1216 sera samples were collected and stored at -20°C until time of analysis.

Sample analysis

Sera were analysed using standard method of indirect enzyme linked immunosorbent assay (ELISA) test at the Veterinary Investigation Centre (VIC), Arusha, Tanzania. The method of analysis was as described by (Ref). After titration with reference to positive controls, samples with ECF antibody titre ≥ 20 PP were considered positive. Titration of cut off points for positive samples of other TBDs was: *Babesia bigemina* (≥ 15), *Babesia bovis* (≥ 25), *Anaplasma marginale* (≥ 15) and *Cowdria ruminantium* (≥ 14).

Statistical analysis

The proportion of positive animals to the total number of animals examined was calculated and expressed in percentages as the efficacy of the vaccine. The comparison of sero-prevalence between groups was checked by Chi-square test. Antibody titres were regressed against the age of the animal and duration after immunisation. The distribution of antibody titre among the immunised and un-immunised cattle was determined. Furthermore, antibody titres among study sites were checked for normality and passed the test hence their means were compared by analysis of variance (ANOVA) using computer software Statistix® (2000).

Results

Response of farmers on protection ability of the vaccine

Of the seventeen interviewed farmers, 14 (82.4%) said that the immunised calves had tremendous survival and growth rates justifying ECF immunisation. They further said that morbidity and mortality due to ECF and other TBDs was remarkably

reduced, and in case of episodes of ECF the clinical signs were mild and responded to treatment after oxytetracycline injection only.

Protection profile of the vaccine

A total of 853 (70%) out of 1216 immunised animals had high antibody titres above the cut off point of ≥ 20 PP; 310 (25%) had low immunity with antibody titre between 0 and 20 PP, whereas 60 (5%) of the immunized animals were negative with antibody titre < 0 PP. Majority of the animals had antibody titre value between 20 and 70 PP; however, few animals had higher values (Figure 1).

Sero-prevalence following immunisation

The sero-prevalences following immunisation was comparable in the two regions namely Morogoro (79%) and Mara (82%), which were significantly higher ($p < 0.01$) than Coast (72%) and Arusha region (32%). Furthermore, sero-prevalence of Coast region was significantly higher than that of Arusha ($p < 0.01$). The antibody titre ranged from -4 to 176 PP. Of the 47 improved cattle and 577 indigenous herds sampled in Morogoro and Coast regions, 38 (81%) and 450 (78%) of improved and indigenous herds, respectively, had antibody titre of ≥ 20 PP. The overall level of protection of un-immunised cattle from Coast (29) and Morogoro (38) was 31 animals equivalent to 46%. (Table 1).

Mean antibody of immunised and non-immunised cattle

The mean antibody titres in non-immunized animals were comparatively low in all animals regardless of the place of origin (Table 2).

Sero-prevalence of other TBD than East Coast fever

Tests against other TBD on cattle from Arusha showed that *B. bigemina* was the most prevalent haemoparasite, followed by *A. marginale*, and *C. ruminantium*, whereas *B. bovis* was found in one animal only (Table 3).

Discussion

Immunisation against ECF aims at acquiring long-lasting protection against the disease and reducing the impact of other TBD in general rather than total tick control, which may be achieved by acaricide application. In this study the overall efficacy of ECF vaccine (FAO₂) was observed to be 70%; this suggests that a susceptible population was converted into immune one after immunisation. In fact, the 70% protection level could probably re-establish the benefit of enzootic stability through ITM. Kivaria et al. (2004) reported similar endemic stability in Ankole calves under natural challenge.

Assessment of the vaccine by analysing the antibody titre post immunisation was thought to be the superlative method because Dolan (1984) noted that immunized animals without detectable antibodies were susceptible to challenge. Thus, effective protection would require high levels of serum antibody capable of neutralizing most, if not all, sporozoites at the site of inoculation or in blood circulation. From these results, therefore, it would mean that, should an outbreak occur in immunised herds at least 70% would survive. Other added advantage is that, immunisation of animals against ECF will switch from strict acaricide application to a more relaxed approach. The relaxed tick control strategy could take care of direct effect of tick bites, other TBD, their toxicosis, and lead to substantial financial savings in both local currency and foreign exchange (Kivaria, 2006). In this study it was observed that there was a difference of antibody titres among the regions, Arusha showing the lowest protection level; inappropriate handling of the vaccine could explain such findings. Inappropriate handling of ECF vaccine could have resulted into inactivation of the stabilises prior to administration. Examination of properly immunized herds that were later maintained tick-free condition for one year demonstrated that their immunity do not wane (Morzaria et al., 1987). In this regard, the percentage of immunity should be interpreted with caution if there were a circulating heterologous strain; vaccine breakthroughs are likely to give disappointing mortality rates in immunized animals. However, in this study there were no such observations.

Absence of antibodies among vaccinates have been previously reported by MacKenzie and Lawrence (1979) seven months post immunization. Such condition poses a risk of disease outbreak in immunised animals. In this study 30% of the immunised animals were at risk of contracting the disease, as the vaccine did not protect them.

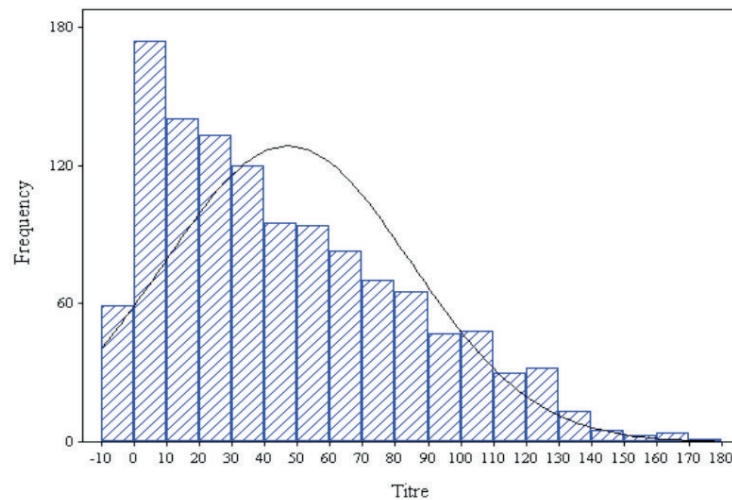


Figure 1. Frequency distribution of antibody titre in ECF immunized cattle

Table 1. Antibody titres among immunized cattle with or without detectable antibody levels from different regions

Region	Total(n)	Cattle with antibody titre ≤ 20			Cattle with antibody titre ≥ 20		
		Number	%	Titre	Number	%	Titre
Arusha	225	153	68	4.4	72	32 ^a	49.9
Coast	208	57	27	10.9	151	73 ^b	47.2
Mara	311	56	18	8.6	255	82 ^c	79.2
Morogoro	472	97	21	9	375	79 ^c	63
Total/Mean	1216	363	29.9	6.8	853	70.1	32.5

Prevalence of antibody titres of immunized cattle with different superscripts in the same column are significantly different from one another ($p < 0.01$).

Table 2. Number of cattle sampled, mean and range of antibody titres

Region	Number of cattle (n)	Group	Mean titre	Range of PP
Arusha	225	Immunised	18.9 ^a	-4 – 134
Coast	208	Immunised	47 ^b	-2 – 107
Mara	311	Immunised	66.5 ^c	-4 – 176
Morogoro	472	Immunised	51.9 ^d	-4 – 132
Coast	29	Control	11.1*	-2 – 40
Morogoro	38	Control	35.5**	-1 – 122

Mean antibody titres of immunized cattle with different superscripts in the same column are significantly different from one another ($p < 0.001$). Controls are compared to each other.

Table 3. Sero-prevalence of other tick-borne protozoan parasites in Arusha (n=225)

Parasite	Cut off	Positive cases	Prevalence (%)
<i>Anaplasma marginale</i> __	PP \geq 15	43	19.1
<i>Babesia bigemina</i> _____	PP \geq 15	54	24
<i>Babesia bovis</i> _	PP \geq 25	1	0.4
<i>Cowdria ruminantium</i> _____	PP \geq 14	25	11.1

Sero-prevalence of 66% from Morogoro-non-immunised cattle indicates that, the area is rather favourable for enzootic stability, particularly in the traditional sector where cattle tend to graze in communal areas, and regular dipping is never practiced. On the other hand, in the Coast region the sero-prevalence of 21% was significantly lower than in Morogoro ($p < 0.05$). Jacobsen (1984) reported similar results of 60-75% in Maputo where dipping was relaxed in opposition to 24% in south of the Mozambique where the vector tick was less found. Such scenarios suggest that in conditions with high tick challenge the protection level is improved and that intensive use of acaricide prevents build up of immunity. In such a situation the disease is likely to occur in sporadic form where mortality figures may be incredibly high. Under such conditions immunisation against *Rhipicephalus appendiculatus* could be considered beneficial during integrated TTBD control.

From the results of this study, it is suggested that the conventional TBD control methods could be integrated with immunisation, which is relatively harmless, inexpensive, less labour intensive and economically sustainable. The use of acaricides is not sustainable in itself because of inadequate number of operational dips, prohibitively high price of acaricide, and laxity of dipping by-laws. Therefore, immunization technique is indispensable option for the control of the most killer TBD, ECF. It has been reported that immunised cattle take longer time to succumb to other TBDs than un-immunised controls (Uilenberg et al., 1976)

The prevalence of other TBD in Tanzania such as babesiosis, anaplasmosis and cowdriosis is rather high than previously known owing to unequivocal immuno-suppression effect of ECF. However, the low prevalence of *B. bovis* suggests that the abundance and or infection rate of the vector tick, *Boophilus microplus*, might be very low in Arusha, Tanzania. Although it is difficult to diagnose *C. ruminantium* due to the nature of the disease (sudden death, need to open skull and make a squash smear, and fast disintegration of the parasite), the sero-prevalence of cowdriosis in this study demonstrates that the prevalence of the disease is higher than previously thought.

Recent mapping of the ECF tick vector, *R. appendiculatus*, has demonstrated that the vector is widely distributed with high intensity in Tanzania except at the central zone and the coastal area, which are lightly affected (MLD report). In this regard, it should be noted that the so-called ECF enzootic, epizootic, and clean zones defined earlier on by McCulloh et al. (1968) have not been static and may no longer be so well defined due to free movement of cattle across the country. This calls for wider use of the ITM method of ECF immunisation and may be included in the integrated TTBD control strategic plans in endemic areas.

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The Effective Eradication And Control Strategies For Tsetse And Trypanosomiasis The Kenyan Experience

Christopher Humphrey Wanga¹ and Leonard Munga²

*Department of Veterinary Services
Private Bag 00625 Nairobi
Kenya*

An extensive literature review on the effective tsetse and trypanosomiasis eradication method strategies in Africa was conducted in 2010 during the formulation of the Tsetse and Trypanosomiasis Eradication Strategy for Kenya spearheaded by Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC), Kenya. Trypanosomiasis is a zoonotic disease transmitted mainly by tsetse flies, *Glossina* genus and affects humans and domestic animals. Tsetse flies are an important livestock disease pest infesting over 138,000 square kilometers in Kenya. Trypanosomes are protozoan blood parasites that cause animal and human trypanosomiasis (sleeping sickness).

Effective control methods are based on:

- Parasite control which involves chemotherapy (use of trypanocidal drugs) to kill the trypanosomes inside the body of the animal. Regular active surveillance (screening) involving case detection and treatment of human /animal trypanosomiasis is necessary in parasite control.
- Systematic vector control which is done through spraying with insecticides, targets and traps technique and the sterile insect technique which targets to kill the tsetse fly in its natural habitats.
- Exploitation of trypano-tolerant livestock through active selection for trypanosomiasis resistant traits in livestock and subsequent breeding.

Over the past 100 years a whole range of control strategies for tsetse and trypanosomiasis control have been deployed in the Eastern, Central and West Africa including Kenya. Unfortunately, none of the methods or a combination of them has led to a lasting solution to the problem of the disease in humans and animals. Consequently, gains made are often lost mainly because land use practices cannot cope with rate of reclamation. Integrated use of the various control methods is the most certain strategy to guarantee trypanosomiasis eradication. Long term commitment rather than supporting crisis management by governments of endemic countries and international community to trypanosomiasis control/eradication programs is essential for sustainability since trypanosomiasis affects the poorest of African countries.

Keywords: Tsetse and Trypanosomiasis; Parasite control; Vector control; Trypanotolerant cattle; Kenya; Long term commitment;

Introduction

Trypanosomiasis is a disease that affects humans and animals and is transmitted by biting insects, mainly tsetse flies. Non-tsetse-transmitted trypanosomiasis mainly affects camels, and is a crucial constraint to the development of the range lands. Cattle, sheep and goats, camels and donkeys are the back bone of the economy in the rangelands. The disease impoverishes livestock farmers and threatens food security. Tsetse flies are probably one of the most important livestock pests in Africa today and new strategies are called for to avert their debilitating effects (Echessah *et al.*, 1997). The increasing levels of trypanocidal resistance - due to usage of the limited number of drugs for over a long period of time, improved tsetse control technologies and increasing demand for land has turned more attention on tsetse suppression and eradication to recover the infested land for increased agricultural production in Kenya (T&T eradication strategy 2011).

The Tsetse and trypanosomiasis (T&T) menace in Eastern, Central and Western Africa is an important constraint to

1 Ministry of Livestock Development P O Box 34188-00100 Nairobi, Kenya

2 Trypanosomiasis Research Centre, Kenya Agricultural Research Institute, P. O. Box 362 0912, Kikuyu, Kenya

agricultural development in the subhumid areas - including the wetter areas of the semi-arid zones - and humid zones of Africa. Tsetse flies infest an area of about 10 million km² stretching across 40 countries in sub-Saharan Africa. The disease affects both humans and livestock. It is currently estimated that about 50 million people (Kuzoe, 1991) and 48 million cattle (Kristjanson *et al.*, 1999) are at risk of contracting trypanosomiasis.

The benefits of T&T control will be derived from a reduced risk of contracting the disease - both human and animal - and therefore decreased incidence of trypanosomiasis, thereby reducing mortality rates and expenses incurred in prevention and disease treatment, and thus improving human health and the productivity of existing livestock (Swallow and Woudy 1994). For decades, standard methodologies for benefit-cost analysis have been applied to assess the most appropriate techniques of T&T control, and to evaluate the benefits and costs of control including those arising outside the direct boundaries of livestock development projects. In recent years, efforts have been directed at understanding and estimating the impacts of African animal trypanosomiasis control on land use and the environment (Reid, 1999; Bourn *et al.*, 2001), and the impacts of African animal trypanosomiasis on livestock productivity, livestock management, crop production and human settlement (Govereh, 1999).

With the variety of technical options now available, there are good opportunities and possibilities for effective control of the disease. However, there will always be a preferred technique, or combination of techniques, for each scenario depending on project size, fly species present, topography, cattle numbers, access, etc. National tsetse and trypanosomiasis control organizations in Africa need to make long-term decisions about which technique or combination of techniques they will use in the future. International donors on their part want to be sure that the appropriate control measures can be used (Budd, 1999). All in all, control programmes designed to reduce the number of tsetse flies and the incidence of trypanosomiasis need to incorporate socioeconomic factors and the cultural dimension as part of the design and evaluation plans while monitoring the implementation process to ensure sustainability (PAAT, 2000, Swallow *et al.*, 1996) (Fig 1).

Animal trypanosomiasis

The major trypanosomes transmitted by tsetse flies that cause livestock disease in Kenya are *Trypanosoma congolense*, *T. vivax*, *T. simiae* and *T. brucei brucei*. Studies have shown that trypanosomes particularly *T. evansi*, are mechanically transmitted by other biting insects, mainly in camels. *Trypanosoma equiperdum* is sexually transmitted. Domestic animals are usually more affected by trypanosomiasis infection while wildlife animals are reservoirs. The disease has a devastating effect on livestock due to increased mortality, reduced milk yield, low live weight gain, abortions, infertility and increased susceptibility to other diseases. The live weight gain and milk production of livestock in the infested areas is estimated at 20% less compared to those in tsetse free production systems (T&T eradication strategy 2011) (Fig 2).

Human African Trypanosomiasis

Human African Trypanosomiasis (HAT) or sleeping sickness (SS) presents in two forms: a chronic form caused by *Trypanosoma brucei gambiense*, which occurs in West and Central Africa, and the acute form, caused by *Trypanosoma brucei rhodesiense*, which occurs in Eastern and Southern Africa. The chronic infection, if untreated, lasts for years while the acute disease may take only weeks to a few months before death occur. The epidemiology of HAT is complex, and transmission cycles are subject to interactions between people, tsetse flies and trypanosomes, and significantly, in the *Trypanosoma brucei rhodesiense* disease, domestic and wild animals as well. In the *Trypanosoma gambiense* disease, the classical human-fly-human transmission cycle occurs in both endemic and epidemic situations (WHO 2010).

Materials and Methods

Research papers, policy and strategy documents, World Health Organization publications, Food and Agriculture organization policy papers, Kenya country livestock disease status reports, African Union IBAR reports, DFID publications, International Livestock Research Institute reports, Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) reports, past T&T eradication program reports, Kenyan T&T Eradication Strategy 2011 and other Trypanosomiasis related literature were reviewed to author this paper.

Findings and Discussion

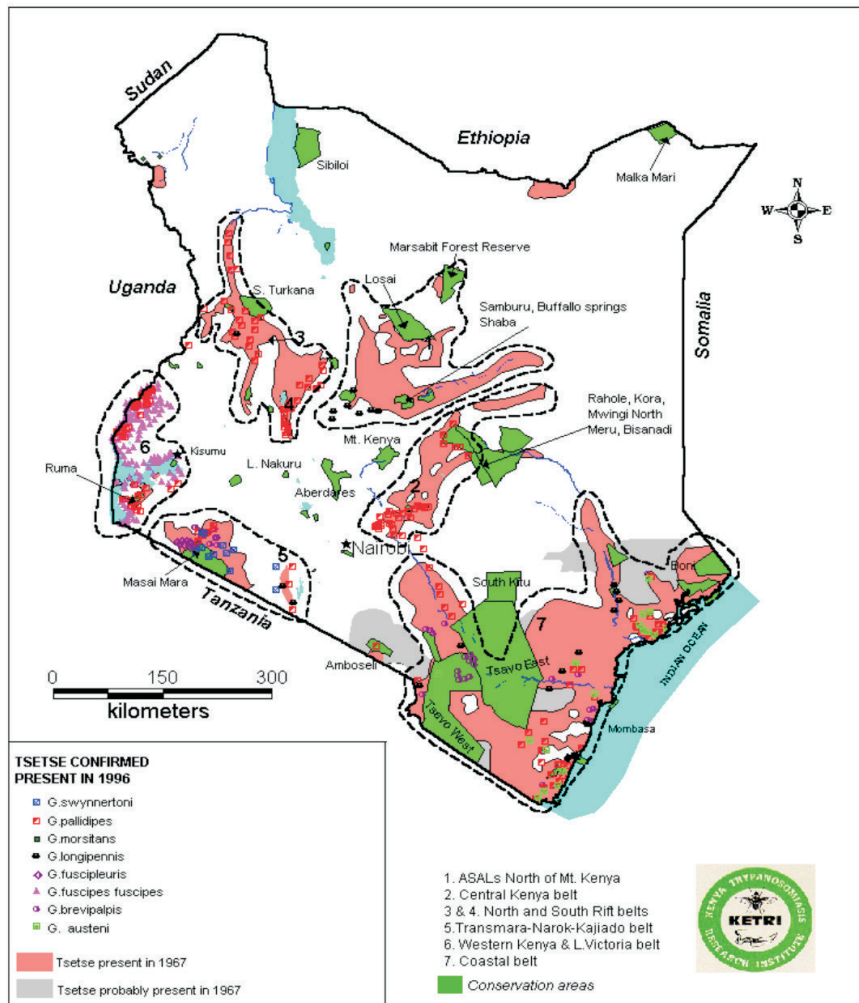


Figure 1: Tsetse Distribution in Kenya (Source KEPRI, 1996).



Figure 2: A cow suffering from chronic trypanosomiasis (photo by M.cheruiyot, Faza Island, April 2009)

Approaches used to control trypanosomiasis include, parasite control, vector control and the exploitation of trypanotolerant livestock.

Parasite control

The most commonly used method for control of bovine trypanosomiasis in sub Saharan Africa is based on trypanocidal drugs (chemotherapy). Cattle are now found in many tsetse infested parts of Africa because of the availability of trypanocidal drugs. If trypanocidal drugs are properly used, they can provide a cost effective and sustainable approach to trypanosomiasis control. Drugs can be highly effective provided they are continuously available and administered properly. The drugs can therefore offer the possibility of reducing the disease to a level where infested land can be utilized economically with minimum risk of contracting trypanosomiasis. Moreover, the use of drugs to protect cattle could allow more effective cultivation, which in turn decreases the amount of suitable tsetse habitat (T&T Eradication Strategy 2011).

Chemotherapy of trypanosomiasis in domestic animals is at present dependent upon a small number of compounds, namely: homidium, isometamidium, diminazene quinapyramine and cymelarsan. Most of these compounds have been on the market for about 50 years now and there are reports of drug resistance in many parts of Africa, including Kenya (PAAT, 1998a). Furthermore, because of the close chemical relationships between the compounds, the development of resistance to one compound often appears to be associated with cross resistance to others. Drug prophylaxis should be considered where a proper drug management system could be established and maintained, for example on large farms and commercial ranches with profitable schemes (Codjia *et al.*, 1993).

Vector control

There are several tsetse control/ eradication methods: aerial spraying, ground spraying, traps and insecticide impregnated targets, insecticide treated cattle and the Sterile Insect Technique (SIT). Aerial spraying using residual insecticide formulations have been applied from helicopters to control/ eradicate tsetse flies. Sequential Aerial Technique (SAT) spraying has also been used to treat 10,000km² in Botswana and 48,000 Km² in Zimbabwe. The method has also been used in Kenya, Nigeria, Somalia, Uganda, and Zambia with varying successes (PATTEC, 2005). SAT is used to treat large areas rapidly and is particularly appropriate in protected areas and epidemic situations. It is also suitable where ground access is difficult, dangerous or inaccessible. However, SAT using ultra-low volume (ULV) and non-persistent insecticide is expensive and cannot be implemented in areas with ragged topography (T&T Eradication Strategy 2011). Historically, aerial and ground spraying have been the means used by public agencies to control trypanosomiasis. These techniques formed the backbone of large-scale tsetse control efforts until the 1980s (Swallow, 1994; Barrett, 1997). In recent years, however, concerns about the costs, sustainability and environmental safety of spraying, coupled with financial restrictions, caused a decline in the capacity to organize large-scale operations and the levels of supervision of several national control programmes.

Target and trap techniques are intended to reduce populations of tsetse to levels which reduce the challenge or risks to humans and animals. They are also deployed to prevent re-invasion of the fly from a previously cleared area. Despite successful field trials, livestock farmers in Africa have been slow to adopt traps and targets as a means of tsetse control. Their motivation diminishes after the tsetse population is low as to pose threat to livestock health and therefore community based fly suppression efforts have been difficult to sustain (Okoth, Kirumire and Kapaata, 1991). The development of bait technologies has triggered two important shifts in the research and control of trypanosomiasis beyond the issue of costs and returns. The first is the involvement of beneficiaries as partners in order to contribute to the cost of the research and implementation of control activities while ensuring the long-term nature of the benefits derived from control; (Dransfield *et al.*, 1991);. The second shift is the tendency to move away from large-scale, government-supported schemes to small-scale, community-based interventions where tsetse control can be regarded as a local public good. The new approach has implications for resource-use patterns and the social institutions - formal and informal conventions, norms and rules - that govern the use of resources and human welfare (Bauer *et al.*, 1992; Kientz, 1993 ;). The decline in the use of spraying techniques helped to stimulate interest in traps and targets/screens that are often enhanced with attractant odours. Impregnated traps and targets attract and kill tsetse-fly species in a variety of situations. The technology is relatively simple and less environmentally polluting than spraying. Traps and targets are also inexpensive and lend themselves to possible community participation. Field problems exist, however, with losses because of theft, damage from humans, fire or loss from being washed away in the rainy season. Wildlife can also contribute to the loss of traps and targets (T&T Eradication strategy 2011).

Insecticide treated cattle offer numerous advantages over odour-baited traps and targets. Cattle are used as moving targets and hence no cost for making artificial baits. In addition, the cattle can be moved to spray races or dips rather than staff trekking widely deploying traps and targets. Further, cattle can move to all possible tsetse breeding and resting sites therefore increase contact with tsetse. Moreover, the method can be based on existing infrastructure like dips and spray races which can bring about significant savings in operational costs. Other techniques can be integrated to address areas like hills not reachable by animal targets. Insecticide-treated livestock can be regarded as a modification of the trap and target technique whereby, instead of stationary targets, insecticide-treated domestic animals (treated by dip or pour-on), can be used as “moving targets” (Leak *et al.*, 1995, 1996). Pour-ons are most effective when cattle are present in sufficient numbers and represent the overwhelming proportion of the host complex of tsetse in the area, and when they are presented for treatment on a regular basis. Communities of a few villages increasingly and successfully use dips and hand spraying of pyrethroids to combat both tsetse and ticks.

The sterile insect technique (SIT) is based on the release of male tsetse flies that have been bred and sterilized in the laboratory, which then compete in the control area with the wild fertile males for the females to be fertilized. The male tsetse flies which have been rendered sterile by irradiation are released into the field where they mate wild females, resulting in no viable offspring. Once mated, there is no opportunity for the females to be mated by the fertile males as females mate only once in a lifetime. With the continuous release of sterile males in large numbers, it is possible to eradicate tsetse flies from a particular area. During the most recent campaign in Zanzibar, a ratio of more than 100 sterile males against one wild one was used to eradicate tsetse on the island. The method is very specific and does not pollute the environment. However, the effect on the population only becomes apparent after a period, as opposed to control by instantly killing insecticides. Because of this and to allow the sterile males to be competitive, a substantial fly suppression has to precede the application of SIT, which is reserved for the final “mopping up” of the remaining population (Cuisance *et al.*, 1984). The technical feasibility of the SIT for tsetse control has been proven in a number of pilot programmes in East and West Africa (Brandl, 1985, 1988). Perhaps the most notable example of the success of the SIT, after tsetse population suppression with targets and pour-on, is the case in Zanzibar where *Glossina austeni* has been eradicated from the island. However, the value of eradicating tsetse from the vast tsetse infested areas using SIT lies to large extent on the cost–benefit justification. The sterile insect technique (SIT) is based on the release of male tsetse flies that have been bred and sterilized in the laboratory, which then compete in the control area with the wild fertile males for the females to be fertilized. The technical feasibility of the SIT for tsetse control has been proven in a number of pilot programmes in East and West Africa ;(Brandl, 1985, 1988). The high cost of the technique and complex logistics have favoured its initial use in a strategy to eradicate tsetse flies from isolated pockets before tackling continuous belts of infested land. The release of sterile males would normally be preceded by a phase of tsetse suppression by the communities using traps, targets, pour-ons and chemotherapy. Community participation is thus a critical contributing factor to the success of this technique (Barrett, 1997).

Use of Trypanotolerant Livestock

It is well-known that innate resistance for many diseases, including trypanosomiasis, occurs in animal populations which have been subject to natural selection by exposure to disease pressure over many generations. In West Africa the N'dama and in Kenya the Orma Boran breeds possess trypanotolerant traits which can be exploited to improve livestock production in the tsetse infested areas. It should however be noted that these animals can act as disease carriers. The husbandry of trypanotolerant livestock remains a control technique that has been used by African farmers for centuries (FAO, 1987; d'Ieteren *et al.*, 1998). Several West African breeds - short- and longhorns - including N'Dama and Baoulé, and a few East African breeds have been shown to have a superior ability to control trypanosomiasis. Indeed, these animals can survive and produce in areas of low to moderate tsetse challenge without the aid of drugs. Trypanotolerant cattle are raised under different management systems, sometimes along with trypanosusceptible breeds. These animals, however, may succumb to trypanosomiasis under high challenge or physiological stress. A trend among livestock farmers in West Africa towards large Zebu-type cattle is perceptible and raises concerns about the risk of extinction of small-sized trypanotolerant breeds (Tano *et al.*, 2001).

Conclusions and Way Forward

Long term commitment rather than supporting crisis management by governments of endemic countries and international community is essential in order to achieve trypanosomiasis eradication. The Integrated use of control methods should be

employed for effective removal of negative effects of tsetse and trypanosomosis. In addition, factors that militate against the effective use of existing tools such as continued worsening economies and structural adjustment programs in the affected countries should be addressed. Finally, there is urgent need for improved support to tsetse and trypanosomiasis research in order to develop more effective and affordable tools as the disease affects the poorest rural communities in Africa.

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Preliminary Observation on Foot and Mouth Disease in the Trans-Boundary Areas of Ogun State, Nigeria

Adewale Oladele Talabi¹, Mufutau Atanda Oyekunle¹, Ibronke Kofoworola Oyewusi¹, Adekayode Olanrewaju Sonibare¹, Ebenezer Babatunde Otesile¹ and P.A. Okewole²

*College of Veterinary Medicine
University of Agriculture
PMB 2240, Abeokuta
Nigeria*

An assessment of Foot and Mouth Disease (FMD) in cattle entering Nigeria from the Republic of Benin by hoof along a major trans-boundary route was carried out. A total of nine herds were clinically examined; many animals were lame, with ropy salivation and oral lesions characteristic of FMD. Samples of vesicular epithelium were collected from animals with classical oral lesions using sterile swab sticks into bijoux bottles containing virus transport medium. These were placed in a labeled cooler containing ice-pack, sealed and sent for confirmation of FMD in the World Reference Laboratory for Foot-and-Mouth Disease (WRLFMD), Institute for Animal Health, Pirbright, UK through the National Veterinary Research Institute, Vom, Nigeria. Out of the nine samples submitted, four (44.4%) were positive for the presence of FMD virus using Polymerase chain reaction. The significance of FMD in cattle entering Nigeria through the trans-boundary area of Ogun State was discussed. By this result, cattle passing through the border should be regularly monitored and screened for diseases of economic and/ or epizootic importance to minimize spread of trans-boundary diseases to the national herd.

Keywords: Foot and Mouth Disease, Cattle, Trans-boundary, Nigeria

Introduction

Foot and Mouth Disease (FMD), is a highly contagious viral disease of cloven-footed animals and is one of the most important economic diseases of livestock (Molla *et al.*, 2010) including domesticated ruminants and pigs and more than 70 wildlife species (Mwiine *et al.*, 2010). The disease causes greatest production losses in intensive dairy and pig production systems (Molla *et al.*, 2010). Foot-and-mouth disease virus (FMDV) is the causative agent (Habiela *et al.*, 2010). It belongs to the genus *Aphthovirus* in the family *Picornaviridae* and possesses a single strand of positive-sense RNA genome. It has a high mutation rate because the viral RNA-dependent RNA polymerase lacks proofreading ability, resulting in seven immunogenically distinct serotypes (O, A, C, Southern African Territories [SAT] 1, SAT 2, SAT 3, and Asia 1) and numerous and constantly evolving variants showing a spectrum of antigenic diversity (Ayelet *et al.*, 2009). The genetic differences are caused through a very wide variation in the protein VP1.

FMD can cause a high number of deaths among young animals and production losses in adults (Ayelet *et al.*, 2009) and is a major constraint to international trade in livestock products and is an effective barrier to markets with the highest prices for these products (Molla *et al.*, 2010). Vaccination is an effective way to control FMD; however, the protection conferred by vaccination or infection is usually serotype specific and sometimes incomplete within a serotype (Ayelet *et al.*, 2009).

FMD is endemic to sub-Saharan Africa; widespread outbreaks of clinical disease occur during most years (Sahle *et al.*, 2004). The major route of transmission of FMD is through aerosol. Other routes include contact with infective material or discharges, through carrier animals, by ectoparasites, experimentally by artificial insemination and use of FMD infected carcasses as meat scraps in pig farming.

A significant amount of cattle enter Nigeria on daily basis from the Republic of Benin by hoof along the Iwoye-Imeko-Olodo-Abeokuta route. This paper reports the FMD status of some of these animals.

Materials and Methods

1 College of Veterinary Medicine, University of Agriculture, PMB 2240, Abeokuta, Nigeria.

2 Central Diagnostic Laboratory, National Veterinary Research Institute, Vom, Nigeria

Location of study: The study was carried out in Yewa division of Ogun State, Nigeria in November 2008. The location of study is bound to the west by the Republic of Benin, with which it shares 155 kilometres of International boundary, within latitude 6° 15' N and 7° 58' N in a deciduous/derived Savannah zone of Nigeria (Onakomaiya *et al.*, 1992).

Clinical examination: A total of 9 herds of between 34 and 72 heads of cattle entering Nigeria from neighbouring West African Countries by hoof along the Iwoye-Imeko-Olodo-Abeokuta route were clinically examined for Foot and Mouth disease lesions.

Sample collection: Samples were collected with the permission of the owners in November 2008. Animals with lesions resembling FMD were noted, clinically examined and oral lesions containing vesicular epithelium collected using sterile swab sticks into bijoux bottles containing virus transport medium. All the samples were placed in a labeled cooler containing ice-pack and sealed.

Laboratory examination of the samples: Samples were sent to the World Reference Laboratory for Foot-and-Mouth Disease (WRLFMD), Institute for Animal Health, Pirbright, UK through the Central Diagnostic Laboratory, National Veterinary Research Institute, Vom, Nigeria, for confirmation of FMD.

Results

Affected animals were dull, anorexic and pyrexia, with drooling of saliva. There were erosions of the mucosa on the oral cavity, especially on the inner lips, around the gum and on the tongue. Erosions also appeared on the feet, in the interdigital space at the bulbs of the heel and around the coronet resulting in lameness. Out of the nine samples submitted, four (44.4%) were positive for the presence of FMD virus using Polymerase chain reaction (Table 1).

Table 1: FMD Detection from Oral Swabs

Herd No	PCR Result	Result by Cell Culture/ELISA
1	Negative	No virus was detected
2	Positive	No virus was detected
3	Negative	No virus was detected
4	Positive	No virus was detected
5	Negative	No virus was detected
6	Positive	No virus was detected
7	Positive	No virus was detected
8	Negative	No virus was detected
9	Negative	No virus was detected

Discussion

The results of this study indicated that some cattle entering Nigeria through the border areas were positive for the presence of FMD virus using Polymerase chain reaction (Table 1). However because no virus/antigen was detected by Cell culture or ELISA possibly due to late period of sample collection, it was not possible to characterize and identify which particular serotype(s) that caused the infection.

Diseases such as FMD require particular attention. The long campaign to eradicate rinderpest diverted attention and effort from FMD control in West Africa. Furthermore, the economic impact of FMD, particularly the reduction in milk production and depreciation in the value of meat (due to weight loss in the animal and the reduction in meat quality), has been overlooked or is not well understood by livestock-owners. These factors, combined with the low mortality rate of the disease, may explain the relative lack of attention to FMD throughout the African continent (Sangare *et al.*, 2004).

The first reported outbreak of FMD in Nigeria was in 1924 and was caused by the FMD Type O virus, a type that was last recorded in Nigeria in 1963. Between 1964 and 1974, Types A, SAT1 and SAT2 were prevalent in the country, with Type A being the most prevalent for ten years. SAT1 made its first appearance in Nigeria in 1968 when about 60 outbreaks of the disease were recorded in the north-east and north-west, Benue-Plateau, and Kwara states. SAT 2 was first recorded in 1973 -1974 from western, north-central, north-east, Kano, Kwara and Lagos states (Obi *et al.*, 2009).

The presence of FMD in a country is a major obstacle to the development of agriculture because of its adverse effects on livestock production and agricultural exports. The eradication of FMD in sub-saharan Africa by the implementation of slaughtering-out is not practicable for various reasons, but vaccination with good quality FMD vaccines can help prevent losses in stock production and reduce the overall incidence of the disease.

The result that 44.4% of the suspected animals entering Nigeria is positive for FMD in this study is an indication that FMD viruses may be entering the country on daily basis via animate vectors. With no control and preventive measures in place, FMD will continue to cause substantial economic loss to farmers and to the nation. To initiate control measures for FMD, the following must be identified: origin of infection, links between outbreaks, extent of genetic variation of the causative viruses, and antigenic relationship of field isolates to the available vaccines (Ayelet *et al.*, 2009).

As these animals may be carriers of a wide range of other economic important diseases, the control of which may be very expensive, they should be regularly monitored and screened for diseases of economic and/ or epizootic importance to minimize spread of trans-boundary diseases to the national herd. In conclusion, there is need for a nationally coordinated comprehensive study of the FMD serotypes in Nigeria for effective vaccine production.

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The Challenges of Transboundary Animal Diseases in Africa: Disease Management Options

William Amanfu

*PO. Box AC 201
The Arts Centre, Accra
Ghana*

Transboundary animal diseases (TADs) are defined as highly contagious diseases that are of significant economic, trade and/or food security importance for a considerable number of countries; which can easily spread to other countries and reach epizootic proportions; and where control/management including exclusion, requires co-operation between countries. Several international fora and institutions have emphasized the need to prevent and control TADs due to their strong impact on livestock agriculture, trade and food security. In Africa, the principal TADs of socio-economic importance are Contagious Bovine Pleuropneumonia (CBPP), Rinderpest (RP), Foot and Mouth Disease (FMD), *Peste des petits ruminants* (PPR) African Swine Fever (ASF), Rift Valley Fever (RVF), Newcastle Disease (NCD) and quite recently [2006/2007], Highly Pathogenic Avian Influenza (HPAI). Although Rinderpest has been eradicated globally, lessons learnt in the application of disease prevention and control methodologies to this disease, are relevant to the management of other TADs that still affect many countries in Africa. The livestock sub-sector represents a major supply of essential food products, a major source of employment and a source of farm income. In traditional livestock production systems, it contributes to draught power and manure for crop production and movement of farm produce and hence contributes to household food security. Therefore, counter-epizootic methods adopted to control and prevent the spread of TADs have a salutary effect on peoples' livelihoods. Africa's capacity to deal with outbreaks of TADs has over the years, been eroded by weakened Veterinary Services and manpower limitations. This presentation discusses the current epidemiologic status of principal TADs in Africa and disease management options that can be adopted for their effective control to ameliorate the impact of outbreak of TADs on people's livelihoods and general well being.

Introduction

Within the African perspective, the situation of infectious animal diseases of transboundary nature has worsened since the last quarter century; Rinderpest outbreaks in the 1980s, CBPP, ASF in the mid 1990s, FMD-outbreaks throughout this period and HPAI outbreaks in 2006/2007. The reasons for this are many, suffice it to suggest that unregulated animal and animal product movement, weakened Veterinary Services, climate change and changes in animal production dynamics, are but few of the reasons for this state of affairs. The development of livestock in Africa is seriously constrained by animal diseases with major socio-economic, nutritional and public health consequences for households, countries and the rest of the world. In addition to the direct loss of livestock due to death and reproductive health failures in animals affected by TADs, outbreaks of rift valley fever in year 2000 and subsequently in 2006/7 in some countries in the Horn of Africa resulted in cessation of the lucrative trade in small ruminants to some countries in the Middle East. In the past three years, PPR has caused massive mortality in small ruminants in northwestern Kenya, northeastern Uganda and parts of Tanzania. PPR is gradually spreading and could reach the larger areas of Southern Africa Development Community (SADC) region where the disease has not been reported except in Tanzania. Other TADs such as FMD, CBPP, ASF and Newcastle disease may not pose a direct human health threat, but have devastating impacts on food, trade and economic security. From this perspective, there is therefore ample justification to mount disease prevention and control actions if peoples' livelihoods are to be improved and maintained.

The Global Framework for the Progressive control of Transboundary Animal Diseases, GF-TADs an FAO-OIE initiative, has the following pillars geared towards the rationalization for the control of TADs globally

- To improve the protein food security, alleviate poverty, and improve the incomes of countries
- Safeguard the world livestock industry (of developed as well as developing countries) from repeated shocks of infectious animal disease epizootics

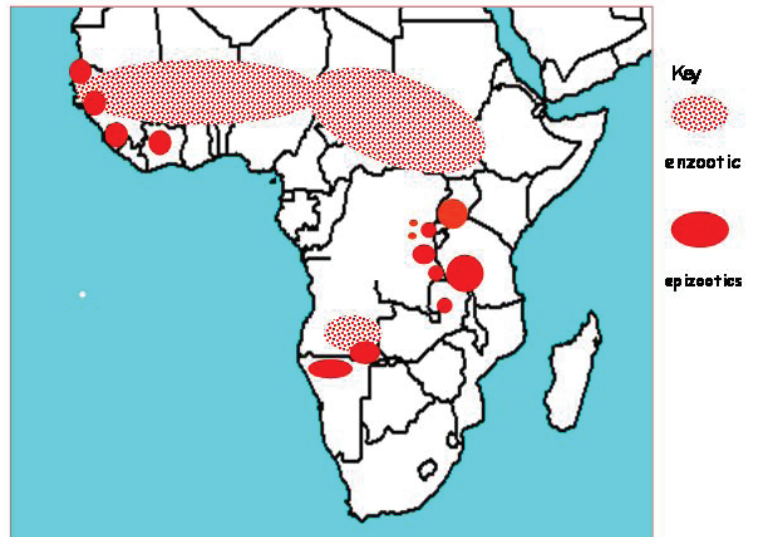
- Promoting safe and globalized trade in livestock and animal products
- Controlling TADs at source

Contagious Bovine Pleuropneumonia

Contagious bovine pleuropneumonia is an insidious pneumonic disease of cattle caused by *Mycoplasma mycoides* subspecies *mycoides* small colony variant (MmmSc). The disease is characterized clinically by dyspnea and pathologically by fibrinous pleurisy and lung marbling. CBPP disease represents a major constraint to cattle production in Africa and is regarded as the most serious infectious animal disease affecting cattle now that Rinderpest is eradicated from the continent (Amanfu, 2009). In the 1970s, the disease situation seemed to be under control and as such, the interest of veterinary authorities, regional and international animal health organizations shifted towards priorities other than CBPP. However, after almost 20 years of respite, CBPP made a come back on two major fronts - one in the east of the continent and the other in the south (Fig 1).

The chronology of events on CBPP outbreaks in Africa shows two distinct epidemiological trends. Reasons for the upsurge of CBPP have been analysed and presented by Amanfu (2009)

Live attenuated CBPP vaccines in use for the control of CBPP, are a compromise between virulence, immunogenicity and safety (Lubroth *et al.*; 2007). It has been argued in certain quarters that improving the quality of existing CBPP vaccines is more likely to deliver significant beneficial effects than developing new generation of vaccines, which will be an expensive and time consuming process (Amanfu, 2009). The control/eradication of CBPP by affected countries appears uncertain partly due to missing gaps in the pathogenesis of the disease, lack of plausible epidemiological data from which sustained control actions could be based, weak veterinary services and poor economic standing of most countries affected by the disease in Africa. The feasibility of the use of currently available tools for diagnosis and control coupled with reinforcement of awareness creation, disease search using community based animal health workers, must be strengthened to bring hope to cattle farmers in Africa. The control of CBPP in Angola is essential and pivotal to the mitigation of risk of CBPP spread to SADC countries. A template for prevention and control was presented by Windsor (2000)



Foot and Mouth Disease

Foot and mouth disease is a highly contagious RNA viral disease of cloven hoofed mammals. The disease is considered globally as one of the most economically important diseases and is a threat to livestock production and agricultural development. Despite the fact that there are numerous viruses (serotypes) that cause clinical disease characterized by a variety of lesions and a drop in productivity, the most important aspects of FMD is its impact on trade in animals and animal products (Lubroth *et al.*; 2007).

Seven immunologically distinct FMD viruses occur globally namely types A, O, C (so called European types), Asia 1 and the three South African Territories (SAT) types 1, 2 and 3. This serological classification is based on the inability of the viruses from different types to induce cross-protection in animals (Pereira, 1977). In Africa, six of the seven serotypes indicated above, occur. Like CBPP, FMD is severely under-reported and available information therefore is incomplete. Countries reporting FMD outbreaks can be viewed at the website of the World Organization for Animal Health–(OIE) www.oie.int

In Africa, types O, SAT1 and SAT2 are widely distributed whilst types A, C and SAT3 are less common. The epidemiology

of FMD in Africa is further complicated by reservoir in the African buffalo - *Syncerus caffer*. Pastoralism, transhumance, informal livestock market and the high livestock wildlife interface that are common on the continent, favor continued FMD virus circulation

Constraints to FMD control in Africa include:

- None- effective control of livestock movement
- None or under-reporting of FMD disease outbreaks
- The live with the disease attitude in some countries
- Multiplicity of serotypes thus difficult to control with vaccination
- Underperforming veterinary services
- Low levels of vaccination coverage
- Short duration of immunity conferred by vaccination
- Role of wildlife in the maintenance and transmission of FMD virus
- Conflict with conservationists where fencing has been attempted (South Africa and Botswana.)

The way forward to progressive control of FMD

Total eradication of FMD in Africa is not a feasible technical proposition because of the wildlife involvement. Control of the disease which can be based on regional strategic approach, is advocated in which the principles of the Progressive Control Pathway for FMD (PCP-FMD) are used to minimize risks for FMD virus transmission and disease spread. The PCP-FMD is a set of control program activity stages leading to FMD freedom and roadmaps, which describe the anticipated progress along the PCP at national and regional level upto to year 2020. The PCP approach is non-prescriptive on control options and has the advantages in the initial stages, that modest investments could attain information needed for targeting measures (national strategy development). www.fao.org/ag/againfo/commissions/docs/genses38/Appendix_16.pdf Research is needed in mapping out FMD virus serotypes and vaccine efficacy improvements.

Rinderpest

Rinderpest is a highly contagious disease of cattle and some species of cloven hooved wildlife. This disease has caused massive mortality in cattle and susceptible wildlife populations over the centuries. In the 1970s, the Joint Project (JP) 15 was established by the European Community, FAO and the Africa Union-Inter Africa Bureau for Animal Resources (AU-IBAR), assisted by individual donor countries including African countries such as Nigeria; for the systematic prevention and control of Rinderpest in Africa. As a result of this intervention, Rinderpest appeared to have been eradicated throughout vast areas of Africa. By 1976 when JP 15 ceased, the disease was limited to two principal foci in West Africa and the Somali ecosystem. There were however no funds to maintain the high level of protection established and the disease made a dramatic comeback. This resulted in the establishment of the Pan African Rinderpest Campaign (PARC) in 1986. The World Organization for Animal Health (OIE) played a significant role in the establishment of PARC when the Organization accepted a proposal from its Africa Commission at a meeting in Rabat-Morocco and together with other partners, convinced the European Community to fund the project. The project was implemented by AU-IBAR based in Nairobi-Kenya, with technical support from international organizations-such as the FAO and the OIE.

To ensure the technical quality of vaccines produced for the Rinderpest campaign, the Pan African Veterinary Vaccine Centre (PANVAC) was established by FAO with the support of some donor agencies namely Japan and the UNDP, in Debre Zeit, Ethiopia. One of the main objectives of PANVAC was to ensure the quality of vaccines produced for the Rinderpest campaign. A mop up programme – the Pan Africa Control of Epizootics (PACE) was established and funded by the EU and implemented by AU-IBAR with technical support from FAO and the OIE. This programme was charged with the responsibility of dealing with the final remaining pockets of Rinderpest in the Somali Ecosystem consisting of parts of Kenya, Ethiopia and Somalia. This programme was also charged with developing prevention and control strategies for important animal

diseases in Africa such as CBPP

In 1994, FAO established the Global Rinderpest Eradication Programme (GREP) as a regular programme activity within the Animal Health Service of the Organization, on the sound principle that the global eradication of Rinderpest was technically feasible. The declaration in October 2010 during the World Food Day celebrations, by the FAO Director General that the Organization's programme for the global eradication of Rinderpest was over, in view of the fact that the disease has not been reported in any country for almost 10 years, places Rinderpest in the same class with small pox [in humans] as the only 2 diseases of global significance [animal and human] that have been eradicated from Africa and the rest of the world through concerted and well coordinated international cooperation and actions. The final declaration on the global eradication of Rinderpest will be made by the OIE, FAO and other International Organizations in June 2011.

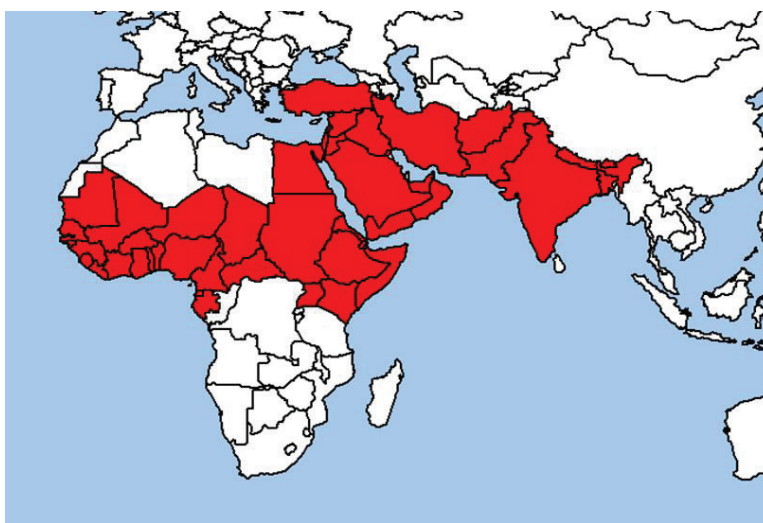
Peste Des Petit Ruminant

Peste des petits ruminants or goat plague was first recognized in West Africa (Ivory Coast) in 1942, and spread progressively throughout most of Africa and elsewhere. The disease is caused by a virus from the Paramyxoviridae family (genus Morbillivirus) and is very similar to the Rinderpest virus. The virus affects domestic small ruminant populations in Africa, the Arabian Peninsula, the Middle East and India subcontinent and parts of Central Asia (Fig. 2). The disease causes mortalities ranging between 50 and 80% in susceptible populations of sheep and goats. PPR in goats must be differentiated from contagious caprine pleuropneumonia (CCPP) because of similarities in some clinical signs and pneumonic lesions encountered in PPR and CCPP. Experience has shown that the onset of the rains and associated high humidity is known to trigger outbreaks of the disease. Although the disease occurs in animals of all ages, the largest prevalence of the disease is found in young stock, usually 2 years old (Rossiter, 2004). PPR is known to be enzootic in West Africa and Central Africa. In Eastern Africa, the disease is enzootic in Ethiopia and the Sudan (Fig 2).

Incursions of PPR into Kenya in October 2006 and Uganda July 2007 were reported (OIE-WAHID) www.oie.int Tanzania confirmed infection in December 2008 (OIE-WAHID) www.oie.int The threat of PPR disease spread to SADC which is currently free, is now a stark reality

Key elements of PPR prevention and control strategy

- Laboratory diagnostic support in capacity building, equipment and reagents for PPR diagnostics, is required.
- Legislative framework for overall animal disease control should be updated to reflect dynamics in PPR disease trends
- Emergency funds must be established to support compensation should there be the need for stamping out or other disease control actions that may require compensation.
- Communications strategy should be put in place that targets policy makers, veterinarians (state/private) emphasizing basic disease recognition, preventive measures and the need for control based on livelihood and food security issues.
- Vaccination- maintaining stocks of PPR vaccines for both emergency and long term strategic vaccination efforts.



African Swine Fever

African swine fever (ASF) was first described in Kenya in 1921. It is a viral disease which has shown a great propensity for sudden,

rapid, unexpected national and international spread over great distances. Presently, there are no vaccines against ASF. The disease is endemic over much of Eastern and Southern Africa. Countries in West Africa experienced massive outbreaks of the disease during the past 15 years and sporadic outbreaks still occur. African swine fever has severely limited the expansion and growth of the pig industry in Africa. Eradication of ASF is currently not feasible because of wildlife cycles of infection between warthogs, other wild pigs and soft ticks (*Ornithodoros moubata*), and also because of endemicity in uncontrolled village pigs. In Africa, current reports of ASF to the OIE have been received from Burkina Faso, Tanzania (Mbeya district) and Kenya (Western/Nyanza Provinces) The disease has recently been reported in Armenia and Russia (OIE-WAHID) www.oie.int

Management of African Swine Fever

- There is no vaccine available for the control of the disease
- Biosecurity measures and good management practices essential for prevention of ASF disease spread
- Movement of pigs and pig products of critical importance in disease management
- Awareness campaigns on disease prevention strategies including the need for the avoidance of movement of pigs and pork products are critical to disease containment.

Rift Valley Fever

Rift valley fever (RVF) is a mosquito-borne viral zoonotic disease generally found in regions of eastern and southern Africa where sheep and cattle are raised. The virus of RVF was isolated in Kenya in the 1930s. The virus also exists in most countries of sub-Saharan Africa (Mauritania/Senegal) and in Madagascar. In September 2000, a RVF outbreak was reported in Saudi Arabia and subsequently Yemen. These cases represented the first Rift Valley fever cases identified outside Africa. Trade bans put in place by Saudi Arabia, resulted in huge financial loss by small exporting countries in Eastern Africa. The occurrence of the disease is usually reliant on the presence of susceptible animals, a buildup of the mosquito vector population (usually associated with heavy rains) and the presence of the virus. In 2010, eight countries reported the disease in Africa, to the OIE (OIE-WAHID) www.oie.int the latest (2011) being South Africa. RVF is known to exhibit a cyclic periodicity of occurrence between 5-20 years. It would appear that the inter-epidemic period is shortening probably due to climatic changes that affect the frequency of above normal heavy rains and increase in population of the mosquito vector.

Management of RVF Outbreaks

- Mosquito control is an essential component of RVF prevention and control.
- Currently, there are two vaccines used in the control of RVF in domestic animals-a live attenuated vaccine and an inactivated vaccine.
- All currently used live attenuated vaccines are based on the Smithburn strain isolated from mosquitoes in Western Uganda in 1944 (Lubroth *et al.* 2007)
- Public awareness campaign and decision support tools essential for emergency preparedness and response

New Castle Disease

NCD is a highly contagious viral disease of domestic poultry, aviary and wild birds. The disease has serious effect on food security and peoples' livelihoods because of heavy mortality encountered in many countries. Conventional vaccines are available for the control of NCD in commercial poultry enterprises. Management of the disease in rural poultry backyard or scavenging birds presents formidable challenges. Apart from the use of conventional vaccines, the use of the thermo tolerant I-2 vaccine strain is gaining popularity in some countries in Africa, within the domestic backyard poultry sector. At the end of 2010, 36 countries in Africa reported the disease to the OIE (OIE-WAHID) www.oie.int Newcastle disease is an important differential diagnostic disease entity with regards to Highly Pathogenic Avian Influenza

Highly Pathogenic Avian Influenza

Outbreaks of highly pathogenic avian influenza (HPAI) were reported in Africa when Nigeria made an official notification to the OIE in February 2006. Eleven countries have so far, reported the disease namely Nigeria, Egypt, Niger, Ghana, Cameroon, Togo, Benin, Sudan (North and South), Djibouti, Ivory Coast and Burkina Faso. Concerted national and international efforts brought the disease under control. Outbreaks of HPAI continue to be reported from Egypt. Apart from Egypt, the last outbreak of HPAI was reported in September 2008, by Togo.

The avian influenza crisis provided an avenue for synergistic actions by both the Veterinary and Medical professions in a manner that has not been witnessed for many years. Mobilization of Veterinarians globally to bring the outbreaks to manageable levels is commendable. The control of HPAI also brought to the fore, the use of communication strategies in ensuring behavioral change as an important tool in animal disease prevention and control strategies.

Conclusion

The prevention and control of transboundary animal diseases require institutional capacity both to detect animal diseases and to contain them at short notice. Such capacity includes effective surveillance and information sharing, well understood operational plans, human capacity improvements, equipment for outbreak containment and diagnosis, and a rapid response system. National and international disease intelligence have to be improved, taking into account public and private institutional arrangements, policies and legislation. The need for co-ordinated financing mechanisms between agencies and across regions, taking into account the multiple players involved, is essential. Transboundary Animal Diseases have public good characteristics therefore public funding of their control is often necessary and justified so as to improve food security and peoples' livelihoods in the long term.

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Pest Des Petite Ruminant (PPR) In sheep In South Western Nigeria - A Worrisome Phenomenon

Jagun A and Onoja A.B***

*Dept. of Veterinary Pathology
Faculty of Vet Medicine, University of Ibadan
Nigeria*

Pest des Petite Ruminante (PPR) belongs to class A group of reportable disease by the OIE (Office des Internationale Epizootics). It is a major cause of colossal loss in small ruminants. A lot has been done in goats in the last ten decades. This study examined the situation in 200 West African dwarf sheep and Yankasa sheep. Pathological lesions were grossly and microscopically examined. Serology was carried out to detect HA/HI antibody levels while virus isolation was attempted. One hundred and sixty WAD sheep and 40 Yankasa were examined, out of which 124 (62%) WAD sheep and 22 (11%) Yankasa sheep had detectable antibody levels. Protective antibody level is 1:56-1:112 and this was found in 146 sheep altogether. This reveals that the protective HI antibody level is very low hence the need for effective vaccination as immunity conferred by this is usually longlasting. This is required in order to maintain a herd immunity that will prevent the level of mortality that is associated with this disease causing agent.

Keywords: PPR, Sheep, Pathological lesions, Protective Antibodies

The Challenges and Prospects of Rwanda Dairy Roadmap

Musemakweli John Baptist

*Rwanda Veterinary Association
PO Box 621, Kigali
Rwanda*

Rwanda continues to face complex socio-economic problems stemming from genocide and previous conflicts, and the legacies of the genocide continue to weigh heavily on the social and economic recovery of the country but 17 years after genocide, the government has put the economy on a rapid growth successfully implementing a broad program of economic reforms as well as creating regional social and economic trading partnerships; Rwanda is now a member of COMESA, EAC and currently a member of the Commonwealth nations. For the last eleven years GDP growth, mainly driven by agriculture and construction, has remained high (between 8 and 11 percent). Inflation has been broadly contained, and the exchange rate is relatively stable. In general, there is evidence of increased economic recovery in Rwanda. The Government has demonstrated a commitment to reconstruction and development evidenced by GDP growth, a poverty reduction strategy, a decentralization program aimed at grass roots democracy, responsive service delivery and greater financial and administrative autonomy and accountability.

The dairy sub-sector of Rwanda has a huge potential as a tool to fight against poverty. The contribution of the livestock sector including the dairy sub-sector to the national economy of Rwanda is relatively low estimated at about 7% to the country's GDP. The current milk production in the country does not meet domestic demand and as such the shortfall in the country is substituted by imported milk and milk products. The Rwanda Dairy Sub Sector plays a very significant role in the GoR's poverty reduction strategy as clearly stipulated in the medium and long-term development frameworks especially, the Economic Development and Poverty Reduction Strategy (EDPRS) and Vision 2020, respectively. Various studies on the dairy sub sector value chains were carried out for the purpose of identifying missing gaps within the whole Rwandan dairy business industry set up. It was from these studies that the ministry developed an appropriate and relevant dairy business development roadmap for the country. The above mentioned studies were commissioned by the "Center for small and medium enterprises program" (CAPMER), currently operating under the Rwanda Development Board (RDB). From these studies which were carried out on each dairy value chain, various constraints were identified, and based on these constraints; appropriate recommendations for sustainable improvement were proposed. The following are some of the recommendations proposed;

- The need for establishment of sustainable collaboration and networking amongst the key stakeholders along the dairy value chains;
- Putting in place an efficient dairy infrastructures; such as, milk collection and cooling centers (MCCs), milk processing plants (MPPs), dairy products transportation facilities, dairy products outlet marketing centers, development of new roads and rehabilitation of rural access roads.
- Mobilizing, strengthening and improving the roles and functions of private sector in the dairy business; notably dairy farmers, dairy farmers' cooperatives, and other key players within the dairy fraternity, and ultimately the umbrella body referred to as "The Rwanda National Dairy Board (RNDB)".
- Development and formulation of the sustainable dairy business environment supported with clear policies, regulations and strategies.

The overall goal of the anticipated Rwanda dairy sub sector development roadmap is therefore to support the sub sector through (i) **genetic improvement**, (ii) **improved feeding of dairy cattle**, (iii) **improved dairy cattle health and husbandry practices**, (iv) **increasing efficiency in milk production, collection, processing, marketing and distribution**. All the above are aimed at increased farmer incomes, which in turn will impact on their improved livelihoods as well as improving and enhancing the Gross Domestic Product (GDP).

1.0. Introduction:

Rwanda is a small landlocked country with a land area of 26,338 square kilometers at an altitude ranging from 1000-4500m above sea level. The average temperatures range between 18 to 24 degrees centigrade with an annual rainfall of 900 to 1800 mm per annum. The country has few natural resources and minimal industry. Rwanda is the most densely populated country in Africa with a population of about 11 million people. The country's population density is among the highest with 400 persons/ km². It is basically an agricultural country with agriculture contributing 40% of the GDP, employing 90% of the population and contributing over 80% of the country's exports. The Rwandan dairy sub-sector has a huge potential as a tool to fight against poverty. It has however been found out that due to the presence of various dairy cattle production constraints, hundreds of thousands of smallholder dairy cattle producers remain impoverished. This has in turn led to the current low contribution of the sub-sector to the country's GDP which is estimated at about 7%. The current milk production in the country does not meet domestic demand and as such the shortfall in the country is complemented by imported milk and milk products. The Rwanda dairy sub-sector development roadmap was therefore developed as a result of various studies that were carried out on the dairy value chains from which related production constraints were identified. The studies were commissioned by the government agency responsible for the development of small and medium entrepreneurs. Various dairy industry development constraints were identified on each value chain and subsequent recommendations aimed at sustainable improvement of each or a group of constraints were proposed. When these recommendations are put into action on what would be called a chronological implementation process towards holistic improvement of the dairying business, it is what has been named the "Rwanda Dairy sub-sector development Roadmap".

For the successful implementation of the above mentioned dairy sub-sector development roadmap, various activities key to value chains improvement should be addressed. To mention but a few are the efficient dairy infrastructure development; i.e. milk collection and cooling centers, milk processing plants, dairy products transportation facilities, dairy products outlets marketing centers, access roads, coupled with the mobilization and coordination of all stakeholders in the sector; mobilization of investors, etc.

This paper therefore, discusses and examines the challenges and prospects identified from the above mentioned studies, it highlights the best thought alternative and sustainable solutions for the implementation of the dairy roadmap for Rwanda. It clearly elaborates the interventions required from various stakeholders along each dairy value chain with the ultimate objective of identifying priority areas for improvement. The paper further evaluates the status and potential of the dairy industry in Rwanda and its impact on the socio-economic development. The socio-economic changes considered are those related to dairy production and productivity and related infrastructure development. The paper also reviews milk marketing systems in Rwanda with special attention to milk processing and marketing channels.

2.0. Methodology

2.1. Information Analysis

This paper is based on information and recommendations obtained from various studies carried out on the dairy value chains and other related sources. Dairy cattle evolution and milk production statistics were sourced from the Rwanda Animal Resources Development Authority (RARDA) of the Ministry of Agriculture and Animal Resources (MINAGRI). The data consists of dairy cattle population, milk production, and infrastructure developed in place; milk collection and cooling centers (MCC's), milk processing plants (MPP's) and milk transportation facilities as well as marketing of dairy products. Other information was obtained through review of various government documents, research reports and publications. This paper also contains information on the future perspectives of the industry which was sourced from RARDA.

2.2. The current status of the dairy industry in Rwanda

Rwanda is a country with a long-standing agricultural and pastoral tradition in which crops and livestock production has always played a very important economic and social role. Specific to livestock production especially dairy cattle rearing and dairy products marketing, the country has at least three different cattle production systems practiced. The most important of production systems are; the extensive, the semi intensive and the intensive production. The government is strongly recommending the intensive type of production to be practiced countrywide. There are different breeds of cattle reared that are the predominant producers of milk available in the country. The Ankole breed which gives 2 to 4 liters of milk per day

is the dominating breed in Rwanda particularly in the Eastern province and accounts for about 70% of all cattle breeds in the country.

By 2009, milk production in Rwanda was estimated at 334,727 tons. On the other hand the estimated total milk requirement for the country 15 years back was 500,000 tons per annum. The country anticipates to have about 505, 816 heads of dairy cattle by 2020 with corresponding milk yield of 900,000 tons.

Table 1: Milk Production Evolution 1994-2009

Year	Milk Production (Tons)
1994	7,825
1999	55,577
2000	57,853
2001	63,484
2002	97,981
2003	113,463
2004	135,141
2005	142,511
2006	156,596
2007	189,827
2008	257,197
2009	334,727

2.3. The Dairy Industry Potential in Rwanda

The dairy sub-sector of Rwanda has a huge potential as a tool in the fight against poverty. The contribution of the

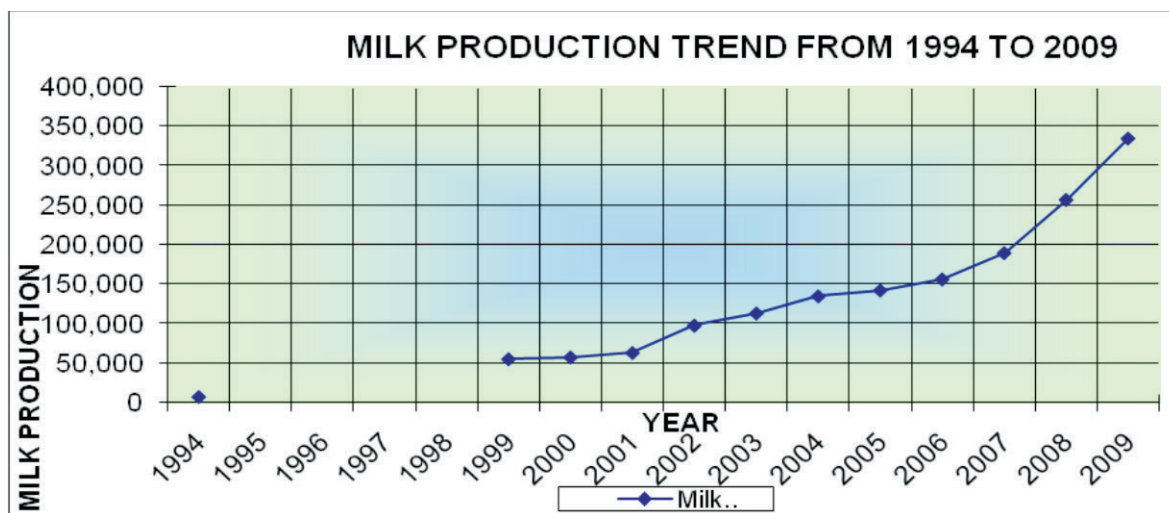


Figure 1. Milk Production Evolution 1994-2009

livestock sector including the dairy sub-sector to the national economy of Rwanda is low estimated at about 7% to the country’s GDP. Overall the current milk production in the country does not meet domestic demand. The shortfall in the country is complemented by imported milk and milk products.

To reduce dependency on imports, several government efforts have been made to stimulate domestic milk production. The government in turn has promoted the market-oriented smallholder dairy production for income generation. Market-

oriented smallholder dairying has higher returns than many traditional agricultural activities and thus offers important income opportunities for resource-poor producer households through their participation in production, processing and marketing of dairy products. Importantly, the keeping of cattle for milk production and sale has been demonstrated to be adoptable by even the most resource-poor households (Figure 2).

Due to various ongoing restocking programs as well as complementing genetic improvement services, it is anticipated that milk production will tremendously leapfrog in the next couple of years to reach 532,514 tons by 2015. It is however

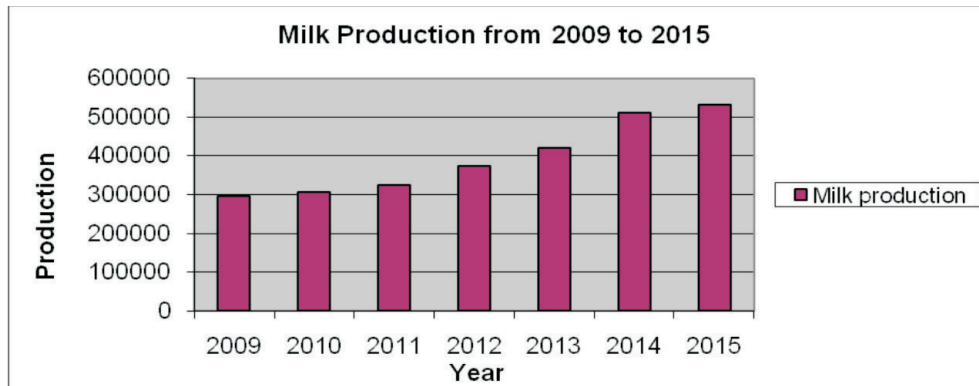


Figure 2. Milk production data (2009-2015)

estimated that by 2020 the volume of milk produced within Rwanda shall reach 900,000 tons and this will bring about a significant difference between consumption and surplus for marketing.

The anticipated growth in demand constitutes an important element to income-generation prospects in the smallholder dairy production system. The potential demand stems from the persistently notable gap between the supply of dairy products and the human population increases in urban areas. Population growth, urbanization, and income growth greatly influence the demand for milk. Experience has it that, urban consumers consume more dairy products than rural consumers in the same income group. As income grows, demand for dairy products can be expected to grow. Meeting the growing demand for milk offers both a major opportunity and a significant challenge to the smallholder farmers.

The huge potential of the dairying industry of Rwanda is further justified by the arithmetic decrease of the imported dairy products over the past couple of years. The chart below shows the trend of imported dairy products from 1990-2007 (Figure 3).

2.4. Factors affecting development of dairy sector in Rwanda

As noted from the studies carried out and the opportunities available for dairying notwithstanding, some critical

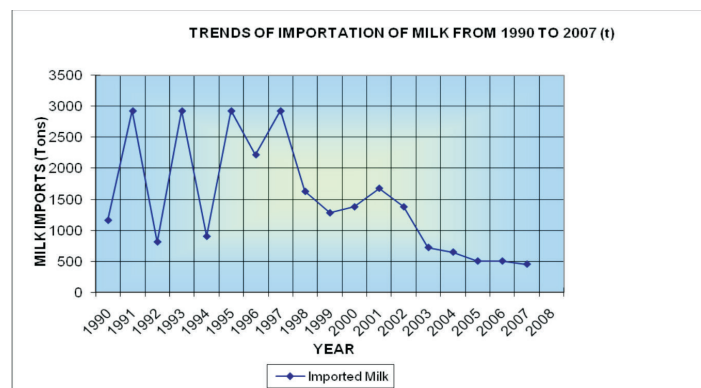


Figure 3. Trends of Importation of Milk from 1990 to 2007 (t)

constraints mitigating the full utilization of the opportunities available to smallholder dairy production in Rwanda exist. These constraints include;

- Poor animal husbandry practices (lack of technical knowhow)
- Lack of improved dairy cattle breeds
- Lack of appropriate technologies for value addition
- Inadequate dairy infrastructures
- inadequate veterinary extension services,
- inadequate and unaffordable veterinary inputs supply services
- Inefficient dairy marketing systems,
- Weak link between smallholder producers and other actors along dairy value chain.
- inadequate government support services,
- Lack of investment capital
- Apparent effects of globalization of dairy products trade,
- The negative effects of the HIV/AIDS pandemic on agricultural production and
- Poor or weak farmer organization development and capacity in all areas of milk production and marketing chains.

The Rwanda dairy sub-sector development roadmap will therefore put emphasis on improving quality and quantity of milk at the farm level on the principle that the quality of milk and milk products reaching the market depends on the milking, handling and preservation practices/technologies at the farm. Additionally, the roadmap intends to add value to raw milk through promotion of small-scale on-farm processing technologies in remote areas where processing plants are very far away. These technologies are aimed at improving quality and reducing wastage of milk and hence improve smallholder farmers' incomes. The technologies will be identified and promoted through farmers' organizations and effective public-private partnerships/arrangements.

3. Vision, Mission and Objectives of dairy sub-sector development roadmap

3.1 The vision of the dairy sub-sector development roadmap in Rwanda

The vision of the dairy sub-sector development roadmap is to create a comprehensive, favourable and economical dairy business setting that would benefit all stakeholders through an organised product value chain essentially for the purpose of increasing income and food security. The roadmap is a blueprint designed to attain the dairy sub-sector vision aimed at improving the livelihoods of the producers.

3.2 The mission of the dairy sub-sector development roadmap

The mission is to increase income and food security for milk producers through sustainable development of the market oriented dairy industry in the country. The move is aimed at ending poverty and malnutrition at household level through increased production, empowering change in skills, knowledge and attitudes of beneficiaries to sustainably integrate dairying into their livelihood systems as well as providing organizational development support. The roadmap will also provide favourable environment for investment in dairy business through development of market oriented dairy production system that takes into consideration all components of the dairy value chain. It will stimulate the milk and dairy products business by promoting marketing competitively within the country and across the region

3.3. Advantages of the roadmap approach

- It identifies points for maximum impact

- It defines and commits all stakeholders and makes them each have role and ownership of actions
- It creates collaborative approach with the whole supply chain
- It reflects impacts of country and regional consumption
- It also checks the anticipated environmental hazards as well as mitigating risks
- It charts inputs and outputs for the whole chain development
- Highlights for the emerging potentials of new production technologies
- It focus strongly on increasing milk yield per cow

3.4. The challenges earmarked to be addressed during the implementation of the roadmap

The objectives of the dairy development roadmap approach stretch out within the holistic improvement actions to various dairy value chains by addressing the following key production aspects;

- Improving dairy cattle management practices (feeding, diseases control and breeding)
- Development of appropriate milk collection, transportation and storage facilities
- Production of hygienic milk at farm-hold level and along the whole chain
- Construction of milk marketing infrastructures
- Establishment of milk processing facilities and infrastructures
- Training of all key stakeholders in the dairy value chain (capacity building)
- Formulation of production/marketing enhancing policies
- Improving marketing of dairy products
- Establishment of farmer/stakeholders cooperatives unions
- Linking all relevant stakeholders in the chain to one another
- Availing financial loaning facilities to the stakeholders

4. Overview of the milk value chain in Rwanda

4.1. Milk Production

The primary entry point in the dairy sub-sector development roadmap is the milk production component. As a rule of thumb good and hygienic milk comes from a well fed and health cow, therefore all efforts to increase hygienic milk production must start or target the cow and the owner of a cow. The following are fundamental issues based on how increased production of hygienic milk from a health cow could be attained.

- First and foremost the cow must be well managed in terms of providing enough and well balanced feed staff and adequate water intake
- Good shelter with clean environment
- Good and timely disease control program
- Healthy and clean milking personnel
- Good knowledge on milking techniques respecting hygienic principles
- Use of proper utensils for milk collection and storage

- Sustainable supply of production inputs (concentrates, drugs, various farm and dairy equipments)

To address the issues related to dairy cattle production and productivity, the government in collaboration with the private sector (producers and input suppliers), has established and put across strategies aimed at increasing production by addressing the following challenges;

- **Improved feeding of dairy cattle;** it should be understood that dairy cattle feeding has remained the major constraint to increased milk production and productivity in the country. In order to address this challenge, there have been concerted efforts by both the ministry of agriculture, NGO's and the private sector of intensive training of farmers in dairy husbandry practices especially on feeding, basic management practices and livestock / crops integration system. The feeding of concentrates, use of crop residues, pasture/forage conservation and integrating leguminous forages with the pasture was highly emphasized. The ministry has established pasture development fields and it is providing pasture seeds of various types to farmers at a subsidized cost.
- **Genetic improvement;** the government has put in place at least a sustainable system of genetic improvement through the use of AI where possible and introduction of proven bulls where AI services does not reach. The system is being operated by private inseminators supported by the ministry through provision of basic AI equipment such as insemination kits, semen, hormones and logistics. The establishment of semen production and liquid nitrogen production units in the country has made the genetic improvement exercise a success.
- **Introduction of improved dairy breeds of cattle;** the government through its various initiatives and in collaboration with other service providers has been and continues to restock the country with improved dairy cattle breeds through importation from neighboring countries and far abroad. It is in such huge programs like 'one cow per poor family' that most of the pure and cross breeds of dairy cattle have been distributed to farmers in the rural Rwanda. Other dairy cows were distributed by NGO's either as service providers or by using their own budgets.
- **Improved dairy cattle herd health;** apart from the tax exemption for livestock production inputs, the government has as well been engaged fully in the prevention, control and treatment of diseases of economic importance for livestock. The ministry has over the past couple of years conducted prophylaxis campaigns against epidemic infections such as FMD, LSD, Anthrax and CBPP. However, the private vets deployed across the sectors in the country are providing veterinary services though not satisfactory as per needs.
- **Increasing efficiency in milk production;** the ministry in collaboration with other service providers has been conducting various trainings aimed at helping farmers to be able to sell milk of high quality. Themes on milking practices; cleanliness of milkers; hygienic principles and the use of clean utensils have been provided to producers.

4.2 Milk Collection

Milk Collection Centers

One of the biggest challenges that the dairy industry in Rwanda has and is continuing to meet is the inadequate milk collection and cooling centres. The ministry established milk collection centers (MCC) composed of small refrigeration tanks that contain at least 2,000 liters. Currently there are over 41 MCC's in total that are operational countrywide. However, other stakeholders such as Rwanda development bank (BRD) have invested into the construction of more MCC's. 70 new MCC's are currently under construction and it is estimated that more MCC'S will be constructed up to 315 in number over the coming years.

Analysis of the studies conducted reveals the following as the major constraints at the MCC;

- Inadequate milk collection and cooling infrastructures
- Lack of adequate infrastructure to ensure optimum hygiene e.g. 69% of the milk collection centers do not have running water, electricity etc
- Inadequate milk collection and cooling equipments (cooling tanks and accessories)

- Weak pricing system of the MCC as they buy milk from the producers
- A large number of isolated milk suppliers in the milk production zones in the country are experiencing poor transport system in milk collection from the dairy farmers and most of them use small plastic jerry cans that lead to poor milk quality
- There exists several intermediaries in the commercialization of the sector, the major part of which being operational in the informal sector of supply and consumption
- Poor organization of the cooperatives running the MCC
- The MCC personnel lack training for improved managerial capacity
- Lack of milk processing plants in zones with high milk production
- The current MCC system of milk supply is inefficient due to the fact that most of the MCC operate far below their full capacity.
- In rain season, certain milk collection centers lack the capacity to collect all milk brought and so are obliged to reject the milk
- There are currently no system for maintenance of power generators and the milk cooling tanks
- The management system and the commercialization does not take into account the profitability of investments made
- The MCC are yet to operate fully in a profitable manner. It has been noted that the annual returns are positive but not sufficient in comparison to the investment made.

To address all the above challenges, the government in collaboration with the private sector, has been striving to initially put in place enough and well equipped MCC's. In view of this there has been a collective approach by various ministries towards preparedness on the anticipated dairy products increase and have come to the following measures;

- Establishment of adequate and well equipped milk collection and cooling centers
- Equipping MCC with running water and electricity
- Sensitize milk collectors for the use of appropriate utensils when collecting milk from dairy cattle breeders
- Improve rural roads to facilitate for all weather collection of milk including evening milk
- Efficient transportation of milk collection at farm-hold level to the milk collection shed/MCC
- Organization of farmers into sustainable farmer cooperative unions aimed at facilitating communal collection and ownership of dairy products as part of doing business process
- Setting up of standards and quality control for milk intended for public consumption
- Establishment of a sustainable milk collection, cooling and storage system
- Establishment of appropriate milk collection and storage enabling policies and frameworks for persons involved in collection and storage of bulk milk business

4.3. Milk Transportation

The critical moment in the milk marketing is the quality, handling and transportation of the product within the required limit period of time. Transport of dairy products has continued to create a greatest challenge in the dairy industry as a whole in Rwanda and other developing nations partly due to inadequate transport facilities and also due to lack of communication infrastructures as well as collection and cooling facilities. In order to improve marketing of dairy products a serious program must be initiated to promote easy transport of these products so that available milk reaches the market without delay. The key constraints that affect milk transportation in Rwanda are as follows:

- Inadequate communication system (poor rural roads, seasonal feeder roads) all contributing to inaccessibility to dairy production zones during milk collection exercise
- Lack of knowledge in better milk transportation technologies
- Poor containers (use of plastic jerry cans) used in milk transportation, inadequate and unaffordable stainless steel cans
- Inadequate number of MCC and lack of appropriate cold chain systems
- Lack of milk tank mounted vehicles for bulk milk transportation

Transportation of milk commences where milk is obtained i.e. from the farm. Farmers are principally transporters of their own milk. Given appropriate milk handling equipment, each farmer would carry his/her milk to the nearby milk collection centers/sheds. The most important parameters that have to be considered include the following among others;

- Basic knowledge on milk handling and transportation
- Milk handling equipments/utensils
- Transportation of milk from farmers to the milk collection sheds
- Means of milk transportation (vehicle used during transportation of milk)
- Distance and time taken during milk transportation from point A to B
- Transportation of bulk milk from milk collection and cooling centers
- Hygiene and cleanliness of milk transport equipment and persons involved in the operation
- Standards and quality control of milk at pick up time and at delivery at the final destination.

Main actions for improvement on milk transportation

A number of activities aimed at improving milk and dairy product transportation have been summed up as follows;

- Organization of milk transporters into groups/cooperatives (farmers/vendors/bulk transporters)
- Training of milk transporters on hygienic milk handling, testing and timely delivery
- Training on hygienic milk transportation (cleanliness of handling and transport equipments)
- Identification of appropriate milk transport vehicles/facilities for small and bulk volumes of milk
- Organization of farmers into groups/cooperatives-for transporting their milk to the nearby MCC
- Traders in milk transport equipments (Private input suppliers) coordinated by PSF
- Ministries concerned to put in place business enabling policies and frameworks for hygienic milk transportation (MINAGRI)

4.4. Milk Processing

Lack of appropriate hygienic milk handling, preservation and small-scale on-farm processing technologies has been found to contribute to wastage and low quality of milk and milk products sold to consumers. Recent studies in the country have shown that more than 60% of marketing agents used non-metal containers. The high perishability of milk requires that some measures be taken to prevent it from souring. Also some studies have shown that the majority of traders did not take any measure to preserve milk between procurement and resale. Milk processing plays a significant role in diversification, quality improvement and product differentiation.

Due to lack of collection and transport facilities, dairy plants present often work at only between 15-30 percent of their

capacities because of the long distances between the milk producing zones and the urban consumption centers where the plants are usually situated. As a result costs of milk collection for plants located near the capital are very high due to fuel prices, poor road conditions (particularly during the rainy season), cost of spare parts and the mileage to be covered. For economic reasons, therefore, dairy plants have tried to restrict milk collection to nearby milk-producing zones, rounding out their daily output through the importation of dried milk and butter oil. The cost of milk collection represents approximately 30 percent of the processing cost of the finished product (packaged pasteurized milk).

In view of the anticipated rapid growth of the dairy industry in Rwanda, the government in collaboration with the private sector should critically look into this component with the purpose of establishing the following fundamental principles of processing of dairy products;

- Establishment of dairy processing plants infrastructures
- Availability of appropriate machinery, packaging materials, etc
- Well established system for distribution and marketing for the value added dairy products
- Strategies for promotion and marketing of finished dairy products are well defined
- Availability of hygienic milk in sufficient quantity and quality
- Reliable and sustainable milk collection, storage and transport system
- Sustainable supply of utilities such as water and electricity
- Analysis of competitive dairy products imported into the country
- formulation of business enabling policies and frameworks
- standardization/harmonization of commodities and quality control
- development and formation of group / organization of milk processors
- identification of dairy products that are of priority to many within the country and in the region
- formulation of packaging volumes in accordance with consumers' preference
- production of high quality dairy products that are competitive
- putting in place appropriate policies and frame works that would promote and protect dairy products produced within
- identification of suppliers of processing machines, materials and equipment
- linking processors with loaning financial institutions

4.5. Dairy products distribution and marketing:

According to the studies conducted it was realized that, the supply and demand factor is key to milk marketing in the country in the sense that there is very limited spectrum of dairy products for sale with respect to consumer needs. Also the low purchasing power of a large group of consumers in the country contributes to poor marketing of available processed dairy products. Furthermore there is an apparent competition between the processed dairy products with traditional products as well as other non dairy consumable products such as mineral water and juices.

During the implementation of the dairy sub-sector roadmap, the following fundamental issues should be considered;

- To conduct dairy products market survey in the country and in the region
- Support the kiosks in acquisition of appropriate equipment for selling milk and milk products
- Promote/organize and solicit various interested entrepreneurs to play an active role in milk and dairy product

marketing

- Train personnel at milk selling points and kiosks in milk storage, handling, hygiene and marketing
- Provide information and sensitize the consumers and the general public on buying and utilization of milk and milk products
- Establish a regular survey to assess the market for milk and dairy products
- Creation of consumer awareness through advertisements, educational programs, pricing policies, development of products per demand, reaching close to the consumer and addressing for their complaints.

Various studies have further shown that the rampant and fragmented milk marketing system has led to opaqueness in milk price-setting with very little bargaining power left to the producers. Price setting is subjective and not related to actual production costs.

5.0. Organizational plan

Having carried out a holistic assessment of the Rwanda dairy industry particularly its opportunities and challenges for development, important decisions and measures need to be taken accordingly based on short, medium and long term activity plans as outlined below.

• Short term activities

- Organize farmers into cooperatives and capacity building
- Train farmers in various themes of interest as regards dairy cattle production
- Improvement of dairy cattle through AI/Bulls scheme/introduction of pure breeds
- Diseases control programs that are economically affordable for smallholder farmers
- Establish input shops/business enterprises for supply of various inputs and equipment
- Avail to farmer's animal feeds resources (concentrates, additives/minerals/vitamins/ good pasture grass etc).
- Sourcing of dairy handling equipment/utensils/ quality testing facilities
- Establish hygienic milk selling points/kiosks
- Link farmers/stakeholders to loaning micro-finance institutions
- Put in place dairy business enhancing policies
- Establish dairy development board for Rwanda
- Put in place dairy cattle breeding policy that could be embedded into the dairy development board attributes.
- government should put in place industrial production policies that are conducive and that enhances dairy products manufacturing where there are no unfair competition with imported goods of similar characteristics

• Medium term activities

- Establish milk collection and cooling centers/ village collection sheds
- Put in place milk collection and cooling facilities
- Rehabilitate and construct rural access feeder roads
- Acquire milk transport facilities-vehicle, bicycles, tanks, bicycle pulled carts etc
- Mobilize private entrepreneurs to venture into dairy business

- diversify processed dairy products for consumer preferences within the country and abroad
- **Long term activities**
 - Establish milk processing plants-Pasteurization/ cheese making
 - Establish ultra heat treated milk processing plants (UHT)

This schedule of activities is a reflection of which activity should come first and which should follow. It is therefore imperative to provide detailed description of how various roadmap activities will be realized based on economic importance of each component and the key role of each activity in the whole process of dairy industry development. The dairy development roadmap should therefore follow the above pattern arranged in chronological order according to the importance of each value chain component and based logically on which should come first and so forth. For the dairy value chain analysis, it is without doubt that dairy cattle production and milk production comes at the forefront of everything followed by collection and storage, then transportation, processing and finally marketing of value added products.

6.0. The envisioned dairy roadmap for Rwanda

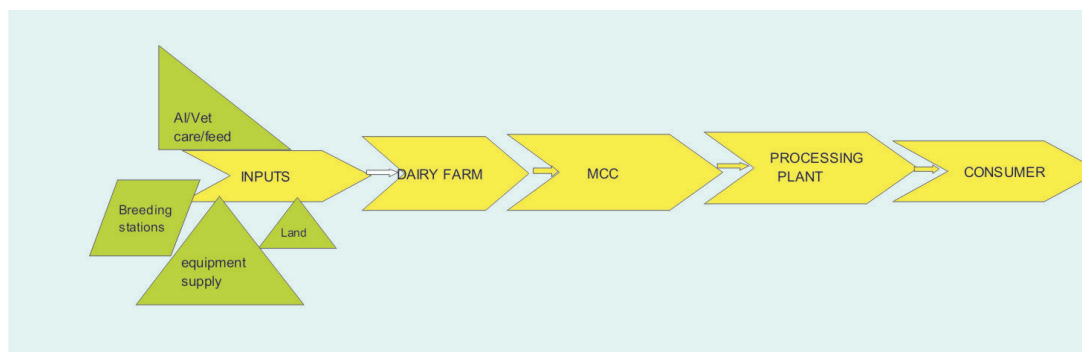
Having analyzed all the studies carried out on each dairy value chain; having critically assessed the challenges and having been able to suggest mitigation measures for the smooth implementation of the roadmap, the following is the kind of model that the Rwandan milk roadmap should take shape of; (figure below clearly describes how the roadmap would look like in future). (Figure 4)

The above envisioned roadmap if reached shall be a breakthrough to the smallholder dairy farmers since they will get higher farm-gate price by either selling directly or through the cooperatives to the processing plants.

6.0. Environmental protection/mitigation measures

During the implementation of the dairy sub-sector development roadmap, environmental protection issues must be considered. The main concerns are those related to solid and liquid wastes originating from farmers' dairy units, milk collection and cooling centers as well as milk processing plants. It is therefore crucial to elaborate some of these environmental justifying risks for the purpose of setting up mitigation strategies. The following are the main waste materials for consideration;

- Animals wastes at the farm-hold level-slurry, dung, gas emissions etc
- Waste water originating from MCC's and Milk processing plants during cleaning: Measures to collect this water into the sewage system should be well established during the construction and establishment of MCC's
- Solid wastes originating from various materials handled at the MCC's and Milk processing plants should be identified and measures to handle them appropriately designed



The envisioned dairy roadmap for Rwanda

- Fumes and smokes originating from generators and other electrical installation should be under control to ensure that dairy products are not contaminated.
- Measures to collect rain water originating from buildings (MCC's and MPP's) should be initiated during construction process-particularly and the collected water should be stored into underground tanks for future use.

7. Anticipated risks:

The important risks over which the dairy roadmap cannot well be implemented, but on which the accomplishment of the program depends include the following:

- Non-conducive political and social environment may hamper roadmap implementation
- Non-conducive economic environment may reduce ability of farmers to purchase inputs and purchasing power of consumers for the quality and value added dairy products
- Free trade in the region resulting to more importation of dairy products may affect demand for locally produced dairy products
- Dairy sector policies that do not enable smallholder dairy development
- Decline in demand for quality milk and dairy products will inhibit adoption of technologies
- Outbreak of livestock disease may affect milk production

8.0. Conclusion:

- The dairy value chain roadmap is a breakthrough to solving the problem of milk production and marketing that the Rwandan dairy farmers have been facing over the past decades. Most of the challenges farmers have encountered during dairy production practices shall be critically analyzed and subsequently solved. The roadmap shall act as a guide for all involved stakeholders and shall be the government's tool to effectively carry out its initiatives for efficient management and control of its scarce resources earmarked for the sector development. Furthermore, the roadmap will act as a stimulus to all key stakeholders including persons and companies from the private sector interested in investing their resources into various businesses in the dairy value chain.
- For effective implementation of the dairy sub-sector development roadmap, dairy production will be reflected from the grass-root level i.e. the smallholder farmer level. Increased income generated from the sale of milk shall go hand in hand with the improvement in dairy cattle management, access to production technologies, increased awareness in dairy business issues, access to credit facilities as well as investment into other income generating activities resulting from diversification of farm and off-farm activities.

On successful completion of the dairy sub-sector development roadmap it is anticipated that about 80% of dairy cattle breeders will be earning over 500 USD per month due to income accrued from the sale of milk and a higher income ranging between 400-800 USD accrued from the sale of heifers and bulls. Dairying in Rwanda is foreseen as one of the high income generating program in the rural poor communities and it would ultimately boost the national economy through its contribution to the national GDP. The poverty level in the rural areas would be reduced significantly as stipulated in the national poverty reduction strategy (EDPRS). It is envisaged that the dairy sector would reduce poverty by 30% after all targeted families have received cows and milk production has started of

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Haematology and Serum Biochemical Changes in the Experimental Lineage 1 Variant *Pestis Des Petit Ruminants* Virus Infection in Goats

Emikpe B.O, Akpavie S.O and Ohore O.G

*Department of Veterinary Pathology
University of Ibadan
Nigeria*

This study describes the haematological and biochemical changes of goats experimentally infected with lineage 1 variant strain of *Pestis Des Petit Ruminants* (PPR) virus. Fifteen goats were infected intratracheally with 1ml of the pure culture of PPR virus grown in Baby hamster kidney cell line with a titre of $10^{6.5}$ TCID₅₀. ANOVA using Duncan multiple range was used to test the significance of the means of the haematological and biochemical values. There was marked haemoconcentration evidenced by increased packed cell volume and haemoglobin concentration over the weeks during the infection. There was significant neutrophilic leucocytosis from the third week ($P \leq 0.05$) while there was an insignificant lymphopenia ($P \geq 0.05$). There was eosinophilia and monocytosis from the fourth week postinfection. The increase in the albumin, Blood urea nitrogen (BUN), creatinine and fibrinogen values from the second week post infection was significant ($P \leq 0.05$). The haemoconcentration may be related to the dehydration resulting from diarrhea. The transient lymphopenia observed between 10-14 dpi reflects the mild virulence of the PPR virus from the lineage 1 while the neutrophilia observed at the third week may be associated with the bacterial complication observed in the course of infection. The serum biochemistry revealed consistent increases in BUN, albumin and fibrinogen values which can be associated with the pattern of pneumonia observed. This study showed that PPR virus from the lineage 1 may be associated with bacterial complication in the later stages and the determination of fibrinogen levels could be of diagnostic value.

Introduction

Pestis Des Petit Ruminants (PPR) is a disease of great socio-economic importance in small ruminant especially in sub-Saharan Africa. It is a major constraint to the development of small ruminant population in the humid zones (Whitney *et al.*, 1967) and the estimated mortality due to the disease in goats varies between 71% and 100% (Nduaka and Ihemelandu, 1973).

The generally acceptable method of control of the disease had been by vaccination of small ruminants in endemic areas using homologous PPR vaccine but despite this approach, the disease is still a problem. The pathogenesis of PPR in small ruminant remains poorly understood as it has been speculated to be similar to that of Rinderpest (Obi and Oduye, 1985). Various investigations have been conducted on the type of pneumonia (Obi *et al.* 1983, Emikpe *et al.*, 2010) and the antigen distribution in tissues of goats infected with PPR virus (Brown *et al.*, 1991, Kumar *et al.*, 2004), with very little information on the haematological and biochemical changes in the course of the disease (Obi and Oduye, 1985, Olaleye *et al.*, 1985, Daneji and Obi, 1994) however, most of these investigations have been inconclusive.

Olaleye *et al.*, (1985) reported polycythaemia, with moderate increase in packed cell volume, haemoglobin and red blood cell count values in experimental PPRV infected goats. These observations are in contrast to that of Obi and Oduye (1985) who reported no significant difference in the erythrocyte indices in both naturally and experimentally PPRV infected goats. Obi and Oduye (1985) also suggested that the degree of lymphopaenia was related to the severity of PPRV infection and that lymphopaenia was probably a direct effect of PPR virus on lymphocytes. On the effect of PPRV on the serum biochemistry however, Olaleye (1985) observed no significant changes in total plasma protein concentration, calcium, phosphorus and blood urea levels in PPRV infected animals but a progressive decline in plasma sodium and potassium levels.

Although the disease has been found to affect haematological and biochemical parameters, information on the sequential haematological and serum biochemical changes during PPRV infection and the effect of the virus on acute phase proteins (Arslan *et al.*, 2007) are few in literature. In an attempt to better understand the pathogenesis of PPRV from the lineage 1 which is the circulating strains of PPRV in Nigeria, (Couacy-Hymann *et al.*, 2007) this investigation was directed at the time course effect of the virus on the haematological and biochemical changes in experimentally induced PPRV infection in goats.

Materials and Methods

Experimental animals

The experimental protocol has been previously described. Emikpe et al (2010b). Briefly, twenty (male and female, n: 10 each) clinically healthy West Africa Dwarf goats (WAD) obtained from a recognised breeding farm, six months of age, of average weight of 6kg were used for the experiment. The animals were divided into two well partitioned pens. Group A had 15 goats while 5 goats served as control. They were conditioned for 14 days before the intervention and vital signs (rectal temperature, pulse and respiratory rates) were monitored daily to observe whether they remained afebrile and free of any clinical signs of diseases. The nasal swabs of the animals were negative for *Mannheimia haemolytica* by cultural isolation prior to inoculation. The animals were also confirmed seronegative by Agar gel precipitation technique for antibody to peste des petit ruminants virus (PPRV) prior to inoculation.

Group A had 15 goats (male:8, female:7) while 5 goats served as control (Group B). The animals were fed daily with cut grass, supplemented feed and clean drinking water was available ad libitum. The study was independently reviewed and approved by an ethical committee of the Faculty of Veterinary Medicine, University of Ibadan and adequate measures were taken to minimize pain or discomfort.

Preparation of PPRV inoculums

The preparation of PPRV inoculums was as described by Emikpe et al. (2009). Briefly, the virus was isolated from ante mortem sample mixed in F-12 Minimum Essential Medium (MEM) containing 10000 units of penicillin, 10 mg/ml streptomycin and 25 mg/ml amphotericin B and gentamycin. The supernatant from the sample was inoculated into (Baby hamster kidney) BHK cell lines and maintained in F-12 MEM supplemented with 5% fetal bovine serum. The cultures were incubated at 37°C and daily examined for appearance of cytopathic effect. The culture which gave a characteristic PPRV Cytopathic effect (CPE) in BHK cell lines was titrated to determine the viral load per ml to enable the calculation of the infective dose. Titration was carried out and the end point was determined using the Karber's formula.

Challenge infection

Goats in Group A were infected intra-tracheal according to the method described by Ames et al. (1985). The infection was done with 1 ml of pure culture of PPR virus grown in Baby hamster kidney cell line (BHK) with a titre of $10^{6.5}$ TCID₅₀. All goats were observed daily for signs of respiratory disease.

Statistical Analysis

ANOVA using Duncan multiple range test of significance for means of the values of the haematological and biochemical parameters.

Results

Haematological Changes

From table 1, the observed haematological changes in PPRV infection are that of marked haemoconcentration evidenced by increased packed cell volume, erythrocyte values (polycythaemia) and haemoglobin concentration over the weeks during the infection. These increases were however not significant ($P \leq 0.05$).

There was an initial decrease of the leukocyte count in the second week, there after a consistent increase in values of the leukocyte count over the weeks. The mean leukocyte value was significant especially in the third week of infection ($P \leq 0.05$). The neutrophilic leucocytosis was significant in the fourth and fifth week ($P \leq 0.05$). There was a general decline in lymphocyte values (lymphopenia) but the decrease was not significant. The eosinophils also decreased moderately (eosinopenia) until the fifth week when there was a sharp increase (eosinophilia). The monocyte values fluctuated but there was an increased especially in the fourth and fifth week.

Serum Biochemistry

From table 2, there was a fluctuations in the total protein, albumin and globulin values from the 2nd week to the 6th week post infection.

The BUN showed a significant increase ($P \leq 0.05$) at 2 weeks post infection accompanied by a significant decrease ($p \geq 0.05$) in 3rd week. The creatinine values increased significantly ($P \geq 0.05$) 2 weeks post infection followed by a considerable fluctuation from 2nd to 4th week. The fibrinogen values increased significantly ($P \geq 0.05$) 2 weeks post infection followed by a considerable fluctuation from 3rd to 6th week.

Discussion

The pathological features of experimental PPR caused by PPR virus lineage 1 (Obi *et al.* 1983, Emikpe and Akpavie 2010), lineage 3 (Abu Elzien *et al.*, 1990) and lineage 4 (Ozkul *et al.*, 2002; Kumar *et al.*, 2004) viruses in small ruminants had been well described with very little information on the haematology and serum biochemistry. This study shows the effect of PPR virus lineage 1 on the haematology and serum biochemical changes in goats.

The review of literatures showed the haematological changes in the first 15 dpi (Obi and Oduye 1985) with paucity of information on the changes post 15dpi. In this study however, there was an initial leucopenia characterized by lymphopenia, eosinopenia and monocytosis which was consistent with the findings of Obi and Oduye (1985) who further reported that the monocytosis was consistent with changes associated with inflammatory disease. The lymphopenia in this investigation was transient and it was observed between 10-14 dpi which was similar to the report of Rajak *et al.* (2004). This mild level of lymphopenia reflects the mild virulence of the virus employed as the level of lymphopenia has been associated with the destruction of lymphocytes by the virus (Obi and Oduye 1985, Rajak *et al.*, 2004). The slight haemoconcentration and polycythaemia observed have been reported by earlier workers (Obi and Oduye 1985). The haemoconcentration is explained by the dehydration that results from diarrhea, one of the clinical features of this disease. However, the diarrhoea in this study was mild and did not occur as early as recorded for the PPR virus lineage 2 and 4 strains where the hemoconcentration reported were marked and significant (Couacy Hymann *et al.*, 2007, Kul *et al.*, 2007). The neutrophilia observed in the third week could be associated with bacterial complication previously reported (Emikpe and Akpavie, 2010b). The highest lymphocyte : neutrophil ratio was obtained in the PPRV group on the second week which corresponded with period of lymphocytosis after an initial or slight lymphopaenia. These results support the report of Obi and Oduye (1985) that the level of lymphopaenia could be use to ascertain the virulence of PPRV. This showed that the PPRV strain one employed in this study was mildly pathogenic and this is agreement with the report of Couacy-Hymann *et al.* (2007). This finding further corroborated the finding of Zahorec (2001) that there is a significant correlation between the severity of the clinical course and the level of lymphopaenia. The ratio of lymphocyte and neutrophil counts (in absolute or relative values) is an easily measurable parameter with less sophistication and the value may express the severity of the complication but this may need further clarification.

The later eosinophilia and marked monocytosis observed from the third week pi may be as result of the bone marrow reponse and the later fibrinous broncho pneumonia observed in the course of the infection (Emikpe and Akpavie, 2010b).

There is dearth of information on serum biochemistry and acute phase protein changes in PPRV infection in goats especially with lineage 1 PPR virus (Daneji and Obi, 1994). The results of the serum biochemistry in this study corroborated the report of Daneji and Obi (1994) who also reported slight increases in total protein especially the globulin fraction and creatinine values.

This study revealed consistent increases in blood urea nitrogen, albumin and fibrinogen values which were in sharp contrast to the report of Daneji and Obi (1994). The observed increase in creatinine values in infected goats in this study can be associated with inflammation and dehydration while the increase in fibrinogen corresponded to the pattern of inflammation observed (Emikpe and Akpavie 2010a). The high BUN also reflect the pattern of the pulmonary lesion and this may be due to the reduced efficiency of the lung as cells are slightly anoxic which in turn leads to higher blood urea levels.

In cattle, the most sensitive acute phase proteins are serum haptoglobin (Hp) and serum amyloid A (SAA), and their concentrations have been reported to increase in response to acute and subclinical inflammation (Winter *et al.*, 2006). The determination of these acute phase proteins including fibrinogen can therefore be of value to the veterinarian in identifying

Table 1: Haematological values of goats in the control and PPR virus infected groups

Parameters	Weeks (Post Infection)					
	1	2	3	4	5	6
Control Group						
PCV (%)	10±0.1	17±0.1	16.5±0.1	1±0.1	16±0.1	10.5±0.1
Hb (g/dl)	8.9±0.1	8.5±0.1	8.5±0.1	8.9±0.1	8.1±0.1	8.5±0.1
RBC (x 10 ¹² /l)	11.11±0.1	11.88±0.1	11.5±0.1	11.85±0.1	11.9±0.1	11.6±0.1
WBC count (x 10 ⁹ /l)	8.5±0.1	7.1±0.1	11±0.1	12.75±0.1	11.7±0.1	12.7±0.1
Platelet count (x 10 ⁹ /l)	16.5±0.1	17.9±0.1	11.7±0.1	11.5±0.1	11.2±0.1	12.8±0.1
Lymphocyte count (x 10 ⁹ /l)	5.9±0.1	6.6±0.1	8.12±0.1	8.71±0.1	8.9±0.1	7.9±0.1
Neutrophil count (x 10 ⁹ /l)	1.21±0.1	1.5±0.1	1.00±0.1	0.8±0.1	0.10±0.1	0.60±0.1
Lymphocyte/neutrophil ratio	1.67±0.1	1.6±0.1	2.7±0.1	2.1±0.1	2.1±0.1	1.7±0.1
Monocyte (x 10 ⁹ /l)	9.9±0.1	11.8±0.1	15.5±0.1	17.5±0.1	19.1±0.1	20.5±0.1
Basin count (x 10 ⁹ /l)	0±0.0	11±0.1	11±0.1	116.5±0.1	106±0.1	19±0.1
PPR Group						
PCV (%)	11.8±0.1	11.7±0.1	10.7±0.1	16.7±0.1	11.8±0.1	7.1±0.1
Hb (g/dl)	7.1±0.1	7.11±0.1	7.96±0.1	8.77±0.1	9.2±0.1	10.5±0.1
RBC (x 10 ¹² /l)	11.01±0.1	10.7±0.1	10.95±0.1	10.51±0.1	11.5±0.1	11.5±0.1
WBC count (x 10 ⁹ /l)	16.6±0.1	17.16±0.1	21.91±0.1	17.86±0.1	16.61±0.1	10.7±0.1
Platelet count (x 10 ⁹ /l)	12.7±0.1	11.6±0.1	19.8±0.1	15.8±0.1	11.0±0.1	10.0±0.1
Lymphocyte count (x 10 ⁹ /l)	10.6±0.1	9.69±0.1	16.16±0.1	7.99±0.1	8.51±0.1	11.6±0.1
Neutrophil count (x 10 ⁹ /l)	5.71±0.1	2.81±0.1	5.71±0.1	6.77±0.1	6.27±0.1	8.±0.1
Lymphocyte/neutrophil ratio	1.8±0.1	7±0.1	2.81±0.1	1.25±0.1	1.37±0.1	1.4±0.1
Monocyte (x 10 ⁹ /l)	16.1±0.1	16.71±0.1	20.1±0.1	9.1±0.1	11.1±0.1	11.7±0.1
Basin count (x 10 ⁹ /l)	0.01±0.1	15.6±0.1	2.87±0.1	8.1±0.1	7.6±0.1	6±0.1

Table 2: Some serum biochemical values of goats in the control and PPR virus infected groups

Parameters	Weeks (Post Infection)					
	1	2	3	4	5	6
Control Group						
Creatinine (µg/100ml)	0.9±0.1	1.1±0.1	0.9±0.1	0.9±0.1	1.0±0.1	1.0±0.1
BUN (µg/100ml)	5.0±0.1	5.0±0.1	7.1±0.1	±0.1	±0.1	±0.1
Total Protein (g/100ml)	6.7±0.1	5.9±0.1	6.6±0.1	7±0.1	6.8±0.1	6.1±0.1
Albumin (g/100ml)	1.9±0.1	2.8±0.1	1.6±0.1	7.1±0.1	3.7±0.1	1.5±0.1
Globulin (g/100ml)	7±0.1	7.1±0.1	0.0±0.1	±0.1	±0.1	±0.1
Fibrinogen (g/100ml)	0.5±0.1	0.17±0.1	0.70±0.1	0.0±0.1	0.50±0.1	0.8±0.1
PPR Group						
Creatinine (µg/100ml)	1.6±0.1	1.6±0.1	1.8±0.1	1.75±0.1	1.9±0.1	1.8±0.1
BUN (µg/100ml)	7.0±0.1	11.0±0.1	6.0±0.1	6.7±0.1	6.9±0.1	6.8±0.1
Total Protein (g/100ml)	11.6±0.1	9.7±0.1	10±0.1	10.0±0.1	9.0±0.1	9.0±0.1
Albumin (g/100ml)	6.0±0.1	6.7±0.1	5.8±0.1	6.0±0.1	5.8±0.1	5.7±0.1
Globulin (g/100ml)	5.6±0.1	1.6±0.1	±0.1	±0.1	7.1±0.1	7.1±0.1
Fibrinogen (g/100ml)	0.5±0.1	1.78±0.1	0.96±0.1	1.70±0.1	0.75±0.1	0.85±0.1

* p<0.05

animals with inflammatory diseases (Karreman et al., 2000) including PPR. The diagnostic tool based on such acute phase protein measurements could considerably improve strategic procedures for control of the infection (Humblet et al., 2006, Sorensen et al., 2006). The plasma concentrations of SAA and Hp and the Hp/SAA ratio has been observed to be useful parameters in distinguishing healthy animals from animals with inflammation and also to distinguish between acute and chronic inflammatory diseases (Alsemgeest et al., 1994). These parameters have been found to significantly increased in PPR infected animals (Arslan *et al.*, 2007). The possible use of fibrinogen/Hp ratio to distinguish between acute and chronic inflammatory diseases in goats as regards PPR need to be investigated.

Since early diagnosis and prognostic evaluation are important in PPR management, acute phase protein levels and changes in the haematology especially lymphopenia may be useful for determining subclinical infection and prevent the spread of the disease (age group, part of the production system), by providing information about the prevalence of ongoing clinical and subclinical infections indicated by the high serum concentration of selected acute phase proteins (Petersen et al., 2003). It may also serve as a prognostic tool, as the magnitude and duration of the acute phase response can reflect the severity of infection (Petersen et al., 2003, Skinner et al., 1991). Hence in a developing economy, fibrinogen, which is easier to evaluate, can be routinely used (Nikunen *et al.*, 2007).

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The Current Status Of Peste Des Petits Ruminant (Ppr) In Sheep In Ibadan Southwestern Nigeria

Jagun A and Onoja A.B***

*Dept. of Veterinary Pathology
Faculty of Vet Medicine, University of Ibadan
Nigeria*

Pest des Petite Ruminante (PPR) belongs to class A group of reportable disease by the OIE (Office des Internationale Epizootics). It is a major cause of colossal loss in small ruminants. A lot has been done in goats in the last ten decades. This study examined the situation in 200 West African dwarf sheep and Yankasa sheep. Pathological lesions were grossly and microscopically examined. Serology was carried out to detect HA/HI antibody levels while virus isolation was attempted. One hundred and sixty WAD sheep and 40 Yankasa were examined, out of which 124 (62%) WAD sheep and 22 (11%) Yankasa sheep had detectable antibody levels. Protective antibody level is 1:56-1:112 and this was found in 146 sheep altogether. This reveals that the protective HI antibody level is very low hence the need for effective vaccination as immunity conferred by this is usually longlasting. This is required in order to maintain a herd immunity that will prevent the level of mortality that is associated with this disease causing agent.

Keywords: PPR, Sheep, Pathological lesions, Protective Antibodies

Introduction

Peste des Petits Ruminants (PPR) is an acute contagious disease caused by a Morbillivirus in the family Paramyxoviridae. These morbilliviruses infect mammalian hosts, and disease is generally confined to one order of mammals; e.g. MV infects solely primates, while RPV and PPRV naturally infect only *Artiodactyla* (cloven-hoofed animals), and CDV naturally infects *Carnivora*.

The disease is included in list A of the International Zoosanitary Code, and is part of the FAO EMPRESS programme (Diallo, 2003). Major PPR outbreaks in Turkey and India have indicated a marked rise in the global incidence of PPRV (Bailey *et al.*, 2005). It is of great economic importance because of the high morbidity and mortality, losses through body wastage, poor food efficiency; loss of meat, milk and milk products and offspring (Nawathe, 1984). The disease adversely affects the income projected by farmers especially women and children who are mostly involved in small ruminant rearing hence its control will assist in the eradication of poverty in developing nations (Diallo 2006).

Sheep and goats are useful to humans during periods of cyclical and unpredictable food shortages especially as a good protein source (Okoli *et al.*, 2005). Their small size and early maturity makes them economically advantageous in small-holder situations than cattle. Sheep and goats appear to withstand drought better than cattle (Campbell, 1978) as they adapt to such environment with their peculiar feeding behavior (Wilson, 1991).

The disease affects mainly sheep and goats and occasionally other wild small ruminants. The natural disease is more severe in goats where it causes heavy losses and it is occasionally severe in sheep (Yesilbag *et al.*, 2005). Many of the previously described outbreaks (Aruni *et al.*, 1998; Rao *et al.*, 1998; Jithendran *et al.*, 2000; Dhand *et al.* 2002 and Kumar *et al.*, 2002) in India were more severe in goats than sheep. But Taylor *et al.*, 2002 stated that PPR outbreaks recorded were in sheep only and in four cases, both sheep and goats were involved.

Obi *et al.* (1983) also reported five field outbreaks of PPR in Southern Nigeria between 1976 and 1980 where, only goats were affected. Similarly, Amjad *et al.* (1996) observed an outbreak of PPR among goats in Pakistan, where sheep kept on the same farm remained unaffected clinically. Taylor (1984) opined that sheep had possible innate resistance to PPR virus. On the contrary, Shankar *et al.* (1998) observed significantly higher incidence rate of PPRV in sheep (39.1%) than goats (23.0%). Reason for such variable epidemiological situation: an outbreak in sheep-only, goat-only or both the species is not known. There is no indication of the existence of variants more adapted to one than to another small ruminant species (Diallo, 2003).

Since most Nigerian small ruminant population consist of goats and sheep, and with goats having contact with sheep flock with persistent sub clinical infection, these may result in reintroduction of the virus from sheep and a more fulminating disease in goats, there is need to study the status of PPR in sheep and the two mentioned breeds as most of the studies in literature are more in goats with very little emphasis on sheep especially in Nigeria (Obi *et al.* 1983., Wosu,1991., Emikpe and Akpavie 2010) . The breed study necessary in southwestern part of Nigeria where the West African dwarf breed of sheep and goat has been presumed to be more susceptible to the disease (Isoun and Mann, 1972). This study reports the current status of PPR in sheep so as to explain its possible role in the epizootiology of PPR of goat in Nigeria.

Material And Methods

Study area

The area of study is situated in Oyo state, the southwestern part of Nigeria, specifically, Ibadan. The city of Ibadan is located on longitude 3.8950E and latitude 7.3790N. The average ambient temperature of the city is approximately $32 \pm 1^{\circ}\text{C}$ in the dry season and $24 \pm 1^{\circ}\text{C}$ in the rainy season with a relative humidity from 46.3 in the dry season to 80.1 in the rainy season.

Animals

Animals of different ages starting from one month but not exceeding five years old were used for the study. These animals have not been previously vaccinated against PPR as reported by the owners. Two hundred Sheep were examined for HI antibodies against PPR virus. Animals reported as having clinical signs of PPRV infection were sampled by swabbing for virus isolation. Gross and histopathology of tissues from morbid sheep among observed cases submitted for necropsy were carried out.

Sample Collection

All animals sampled were identified by head or body marking using a permanent marker. Records of animals, the breed, and sex. Five (5) mls of blood sample was collected per animal. Blood was drawn through a jugular venipuncture into tilted universal bottle to obtain the sera which was transferred into ependorf tubes and kept at -20°C until used.

Serology

Serological analyses to assess the prevalence and level of circulating antibodies for PPR virus were carried out on 200 sera by hemagglutination-inhibition test as described by Wosu (1991).

Briefly, serial two-fold dilutions of heat-inactivated serum are prepared in saline. A 0.25 ml aliquot of each dilution is then mixed with a similar amount of viral suspension that contains 4 hemagglutinating units. These are mixed and incubated. Next 0.25 ml of a 1% erythrocyte suspension is added, and the tubes are mixed again and incubated either at room temperature or 37°C . Tests were read at the end of 45 min when the erythrocyte in control wells settled. The agglutination or absence thereof is read, and the HI titer of the serum is assigned as the reciprocal of the highest serum dilution that completely inhibits hemagglutination.

Gross and microscopic examinations

Necropsy was performed within 12 hours post mortem and intestine, lungs, spleen and selected lymph nodes were routinely processed, embedded in paraffin wax, and sectioned at $5 \mu\text{m}$, stained with Haematoxylin and Eosin and examine under the microscope.

Statistical Analysis

Data obtained were analyzed using descriptive statistics.

Result

PPR infection was diagnosed based on clinical and post-mortem findings which include fever, dry muzzle, cconjunctivitis, ocular discharge and serous nasal discharge which become progressively mucopurulent, marked salivation, profuse diarrhea and dehydration.

The serological evidence of the disease in sheep is shown by HI and the mean data within and between the two breeds is presented in Figure 1. Detectable antibodies of varying titres in 146 (73%) of the sampled population. West African Dwarf (WAD) Sheep account for 124 (62%) positive cases whereas Yankasa was 22 (11%). Seroprevalence was recorded by sex and age both within and between breeds as shown in Figure 2-5.

The postmortem findings were emaciated, soiled hindquarters with soft/watery faeces, ocular and nasal discharges. Lips were swollen and hyperemic with scabs at the commissures, nasal cavity showed congested lining with clear or creamy yellow discharges. The lung showed generalised edema and congestion with dark red pneumonic areas which were firm to touch and areas of atelectasis, the distribution was mainly in the anterior and cardiac lobes and anteroventrally presented. Lymph nodes were edematous and congested, mediasternal and intestinal lymph nodes were most affected. The intestinal lesions were not marked, the abomasum showed mild to moderate congestion. There were areas of congestion in different portions of the small intestine and the large intestine contained varying degree of congestion “zebra stripes” which was more marked at the ceco-colic junction and towards the rectum.

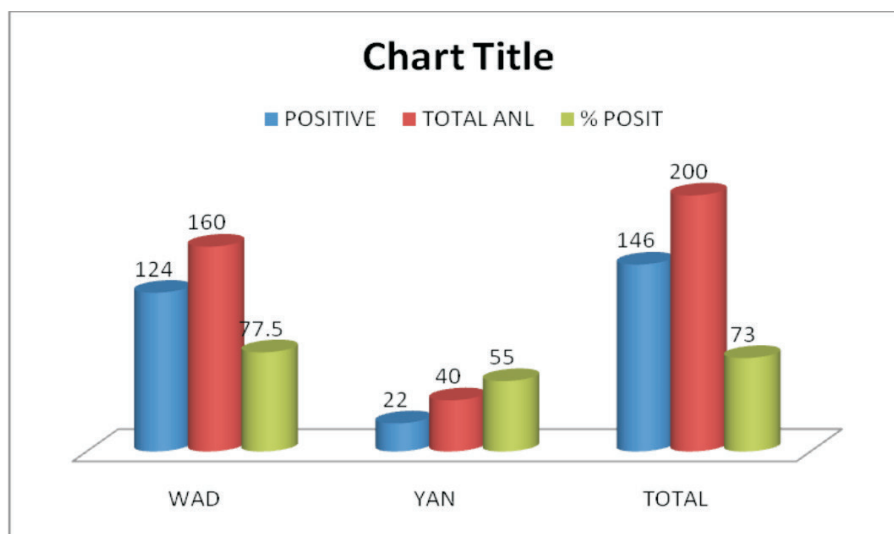


Figure 1. showing seroprevalence in WAD and Yankassa

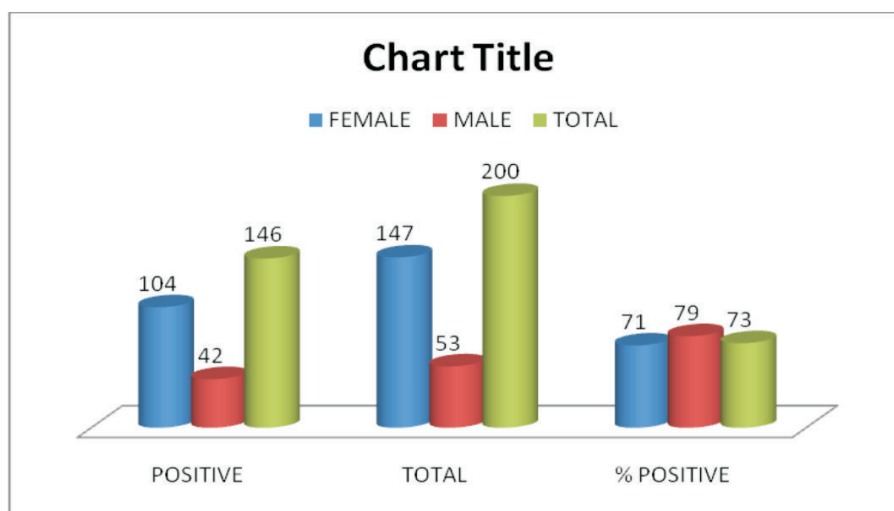


Figure 2. showing seroprevalence by sex distribution

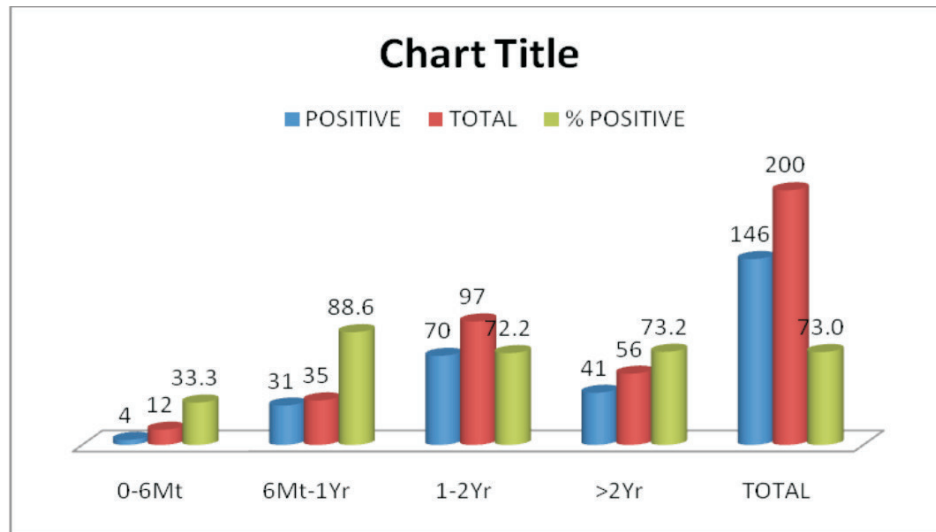
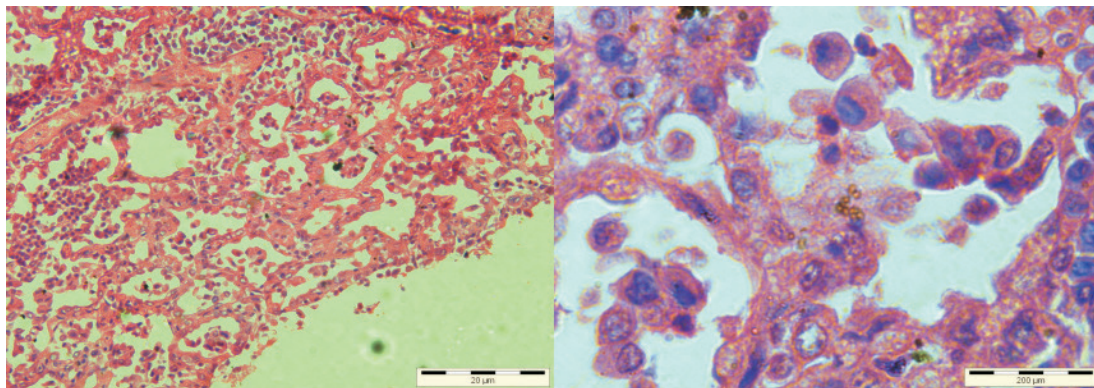


Figure 3, showing seroprevalence by age distribution

The histopathology showed mainly epithelial necrosis of the mucosa of the alimentary and respiratory tracts marked by the presence of inflammation. The lungs showed necrosis of bronchial and bronchio-epithelial cell, type II pneumocytes, syncytial cells and alveolar macrophages. Multinucleated giant cells (syncytia) can be observed in the lungs (Figure 4).

Discussion

Clinical and post-mortem findings may be sufficient for the diagnosis of PPR in endemic areas, but histopathological



examination and isolation of virus are essential in hitherto unaffected areas or areas in which outbreaks occur sporadically (Scott, 1990). In the present study, serology, post-mortem findings and viral isolation of PPR were done to investigate the status of the disease in sheep which has been reported to run a longer course and the sub acute form of the disease (Isoun and Mann 1972, Durojaiye, 1980, Lefèvre and Diallo, 1990; Roeder *et al.*, 1994, Chauhan *et al.*, 2009)

Based on serology, the percentage seroprevalence was 73% of the tested Sheep population. WAD Sheep accounts for 62% while 11% were Yankasa but of the percentage within breed WAD was 77.5% while the Yankasa was 55%, suggesting that the prevalence of the disease is higher in WAD Sheep is similar to observations by Isitor *et al.*, 1984 who stated that West African Dwarf goats are known to be more susceptible than other breeds.

The postmortem findings were similar to the earlier findings in goats but to a lesser extent as there were no erosions or ulcers in the oral cavities which is a prominent finding in goats, the lung pathology was not as severe as what had been reported in goats there were more areas of edema and congestion than areas that showed pneumonia. This further confirm

the fact that PPR is more fulminating in goats than sheep (Roeder *et al.*, 1994, Jithendran *et al.* 2000, Kumar *et al.* 2002, Obi *et al.* 1983) suggesting that the infection is less fatal in sheep. The investigation of the pathogenesis of the disease in sheep could be a leading pointer to treatment or vaccination and better control of the disease. Thus vaccination should be emphasized in sheep as in goat, as the subacute PPR commonly encountered in sheep makes the animal a potential source and threat to the spread of PPR in goat population. This also call for further investigation of the pathogenesis of the disease in sheep and innate response of sheep to PPR virus infection as well as the possible reservoir role of sheep according to Ozkul *et al.* (2002).

However, its circulation in other animals has never been described. In the present work, we showed that the antibody seroprevalence in camel, cattle, goat and sheep confirmed natural transmission in these animals without clinical disease.

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Session 3: Veterinary Education

Needs and tools for High Quality Veterinary Education Worldwide

Tjeerd Jorna

*World Veterinary Association
Sydwende 52 9204 KG Drachten
Netherlands*

Before to start with the presentation of this topic, I would like to mention that the year 2011 as World Veterinary Year is based on the 250th anniversary of Veterinary Education. The founding of the first veterinary school by Claude Bourgelat in 1761 in Lyon is also a landmark for the veterinary profession. Bourgelat has initiated as well the comparative biopathology and in that perspective he is the first initiator in what we mention the One Health Concept nowadays.

The World Veterinary Association [WVA] founded in 1863 as a congress-organising body is professionalized in 1959 to represent the veterinarians in all global veterinary issues. As a small profession we have to speak with one voice and one vision. The WVA is the umbrella organisation for veterinary associations from countries all over the World and for international discipline-oriented veterinary organisations.

The mission of WVA is to assure and promote animal health, public health and animal welfare at a global level and therefore the vision of WVA is to be the global voice for veterinarians in order to strengthen their position to promote animal well-being and to protect public health.

The main goals of WVA are:

- to be recognised as the global veterinary voice
- to promote high quality veterinary education, the topic of this presentation
- to get public recognition of the veterinary profession as a “Global Public Good”
- to support veterinarians in delivering their responsibilities by optimising the preconditions required for fulfilling their tasks
- to ensure and to safeguard the long-term viability of the WVA

The policy areas of the WVA are based on the One Health concept involving animal health and animal welfare, public health and environmental veterinary issues, veterinary education and life long learning and strengthen the veterinary profession. Veterinary Medicine looks like the roof of a temple, church or most with the three pillars of animal health, public health and animal welfare always build on the strong foundation of Veterinary Education.

Education and lifelong learning has to be to develop and to implement a strategy for enhancing veterinary education and skills development; to analyse the evaluation and accreditation systems; to work towards all newly graduates having the necessary Day 1 Competences; to promote the institutionalisation of life long learning programs and to be an active partner in global veterinary education projects.

Evolving veterinary education exists of to develop the minimum requirements for veterinary education for schools in the perspective of the expectation of the Society for new graduates in the veterinary profession and the expectation of the veterinary profession herself about the veterinary training.

The expectation of the Society is that the veterinarian has to act as a link between animals, animal owners and Society. The Society need to have confidence and trust in our high standard of veterinary education and professional implementation.

The Society often knows only the practitioner and have to be explained about all other duties related to human health and public health.

The expectation of the profession is the requirement of a level of education or training provided by the schools that ensures to new graduates to have a solid DOY ONE COMPETENCE for a real professional independent start for the various duties required daily of vets. But the profession has to realise that the Day One Competence is always a Starting Competence.

The responsibilities of veterinarians are to perform all their duties required by Society; to control and promote animal health, animal welfare and public health [including zoonoses.]; to participate in environmental and ecosystem health. Therefore the veterinarian has a role as practitioner; hygienist in meat inspection; state veterinary officer for policy animal disease control and public health; in industry and institutes; in education at veterinary faculties and Agricultural schools; in disease monitoring in environment and by climate change.

Veterinary duties are to prevent and early detect outbreaks of animal diseases; to certify healthy animals for trade; to ensure that products of animal origin are safe; to investigate and diagnose animal diseases and to determine upon correct intervention and treatment

The most important training issues for new graduates as minimum training requirements are to control the major diseases of domestic animals; to Carry out food inspection; to ensure the safety of food of animal origin; to control zoonotic diseases; to conduct research on important veterinary topics and to participate in environmental and ecosystem issues.

For the minimum training requirements that exists I give some examples. The EU Directive 2005/36/EC on the recognition of Professional Qualifications; the AVMA Standards 2010 of an accredited college of Veterinary Medicine of the AVMA Council of Education; and the Minimum Competences OIE 2010 expected of veterinary graduates to assume delivery High Quality National Veterinary Services.

First we have to compose our definition of Day One Competence. In our view the Day One Competence is the combination of knowledge, skills and experience that veterinary graduates need to possess for a safe start entering the veterinary profession to enable them to perform most of the duties that they will encounter.

WVA has given an overview of the global veterinary Day One Competences that you can find on the website www.worldvet.org , but I will repeat the main ones, as there are

- + biological principles and mechanisms underlying animal and disease from molecular and cellular level to organismal and populations manifestations
- + normal physiologic function, homeostasis, pathophysiology, natural history and manifestations of important animal diseases [domestic and foreign]
- + how to obtain adequate case history, properly store and retrieve medical information and communicate effectively with clients and colleagues
- + therapy, practice medicine and surgery applicable to a broad range of species, including disease prevention, ability to apply and interpret physical and laboratory diagnostic methods like diagnostic imaging, diagnostic pathology, biosecurity; therapeutic intervention incl. surgery, patient management and care for individual animals and populations
- + principles of epidemiology, zoonoses , food safety, interrelationship animals and environment and the contribution of vets to public health
- + understanding of production systems of livestock industries, along with understanding of factors limiting animal health and production
- + professional ethics and delivery professional services to the public

- + knowledge, skills, values, attitudes, aptitudes and behaviour to address responsibility the health and well being of animals in ever changing societal expectations
- + an ability to use knowledge to investigate animal health and production issues, to continually seek new knowledge to help improves ability to provide high quality of veterinary care. Recognition of Life Long Learning and improvement as part of their training culture.

The level of global veterinary Day One Competences depends on the quality of Veterinary Education /Training controlled by systems of Accreditation/Evaluation.

I will mention some model of international certification like European Evaluation System; North American AVMA/ CVMA accreditation system; Australasian system, Latin American system ARCOSUR; Accreditation/evaluation systems by the veterinary profession; veterinary statutory bodies or by the schools themselves.

I would like to finish my presentation with to mention some WVA projects and events. WVA is very much involved in all celebrations on a global , regional and even a country level in VET2011. we have had the opening of World Veterinary Year in Versailles near Paris and will have the second World Conference on Veterinary Education in May 2011 in Lyon. WVA will organise the closing ceremony of this important year during the World Veterinary Congress in Cape Town 10 to 14 October. During that Congress WVA organises a Global Summit with as topic Lessons learned and future approaches on the Use of Antimicrobials. WVA is supported by OIE , FAO and WHO.

The most important issue for WVA is communication to become and maintain high visibility. Therefore WVA has her website with every second month the Newsletter and in between WVA started with her INFO NEWS bulletin. To produce information is easy but to get this information read on the right time and on the right places is often difficult also by different language skills.

But WVA is working for the benefit of healthy animals and healthy people!

Animal Welfare Education: “Everybody is Responsible” Also for Vets

Nancy De Briyne

*Federation of Veterinarians of Europe (FVE)
Rue Defacqz 1 1000 Brussels
Belgium*

Review Animal Welfare Teaching in European Veterinary Faculties

The veterinarian is expected to be the animal welfare professional par excellence, having the full range of knowledge and skills required to assess animal welfare, identify problems and make recommendations for improvements. Consequently a veterinarian should be well educated in all aspects of both animal welfare and ethics. This study examined how and to what extent animal welfare is being taught during veterinary education in EU veterinary schools and faculties.

In about 100 establishments in Europe, of which 73 are in the European Union, it takes 5-6 years study to become a veterinary surgeon. Within the EU, mutual recognition of veterinary diplomas has been established by law. This means that EU citizens, who have obtained their veterinary degree and the right to practice in their country of residence, may also practice in other Member States without the need for further examination.

Evaluation reports from 43 veterinary schools in 24 countries were analyzed. Overall, the study illustrates that the way animal welfare is taught differs greatly from school to school. In some of the evaluated schools, animal welfare teaching is firmly embedded throughout the whole curriculum. In other schools, however, animal welfare is almost exclusively presented in terms of legislation rather than from an applied perspective. From these findings, it is recommended that animal welfare is taught from an applied perspective (e.g. practical aspects of welfare on farms, during transport, or at slaughter) instead of addressing only the legislative aspects. Part of the teaching should be done in an interactive way promoting critical analysis of situations from different perspectives.

Infection Prevention and Control Best Practices for Veterinary Clinics: Development of an Educational Program

Patricia V. Turner, Kristie Smith, J. Scott Weese

*Dept of Pathobiology, University of Guelph, Guelph N1G 2W1
Canada*

By the very nature of their work, veterinarians and animal health technicians working in clinical practice are front-line healthcare providers and are often the first to be exposed to animal disease and zoonotic disease outbreaks. This has been demonstrated in recent zoonotic disease outbreaks in which veterinarians or their staff formed the majority of the affected cases or in guidelines in which it is recognized that veterinarians may have significant occupational exposure to disease agents. While outbreaks receive the most attention, there is also a baseline risk of exposure to various infectious agents. There is only superficial understanding of the implications of this. Recent studies have indicated new threats to veterinary personnel and the potential role of veterinarians in dissemination of zoonotic pathogens to the community.

Infection control practices are equally important in veterinary medicine as they are in human hospitals. However, well-designed and implemented infection control protocols are often not present to the same degree in the veterinary setting. It is imperative to animal as well as public health that practices are developed for the prevention and control of pathogens in the veterinary environment. Infection control practices can be modified from human protocols to deal with the constraints of veterinary medicine, such as the potential for transfer of infectious agents between animals, veterinary personnel, and clients. The objectives of this project were to develop a web-based program of study in veterinary clinic biosafety to educate veterinary practitioners, animal health technicians, and clinic managers; and to develop a system for evaluating knowledge gained in the area of infection control practices

The expected outcomes of this project are to address safety and infection control awareness as potential occupational health risks for veterinary practitioners and associated veterinary employees. To our knowledge, this is the first online veterinary practitioner safety/infection control training platform in North America.

CVA Continuing Professional Development Program

Jeff Cave

*PO Box 59, Wodonga, Victoria 3689
Australia*

The CVA has a group dedicated to developing the CVA's continuing professional development (CPD) capabilities. As we now live in the age of the internet the emphasis of the CVA CPD group has thus far been on the provision of on-line resources. Upon saying this, care will be needed in not becoming blinkered to the other ways in which CPD could be delivered, and in reinventing the abundant amount of material already freely available on the internet.

A number of notable achievements have been made. The CVA has been particularly fortunate in having our CVA members be given free access to the New Zealand based *SciQuest*® and the United Kingdom based WikiVet. These will be demonstrated at PCVC5.

In spite of these achievements, the planning and management of the CVA CPD program has been well intentioned and good ideas have been formulated but the approach has largely been *ad hoc*. In attempt to address this deficiency a CVA CPD business plan is being formulated to pave the way forward. CVA members are invited to contribute to this plan. The CVA CPD group will help ensure that the content of the plan is carried out. New Zealand Veterinary Association's VetLearn® could provide the appropriate software on which to base the CVA CPD program. VetLearn® could also be a provider of technology, services and expertise.

Keywords; veterinary education, internet

Introduction

In the mission statement of the CVA it is stated that "The Mission of the Commonwealth Veterinary Association is to promote the veterinary profession within the Commonwealth by encouraging the highest professional standards of education...". The CVA has carried this out in a number of ways including organising workshops and conferences, short term study grants, supporting visiting lecturers and other specialists, a book and journal program, a CVA journal, a CVA website etc.

It was decided at the executive meeting at PCVC4 in Barbados in 2007 that the CVA would establish a group dedicated to developing the CVA's continuing professional development (CPD) capabilities.

As we now live in the age of the internet the emphasis of the CVA CPD group has thus far been on the provision of on-line resources. It was recognised that a high percentage of people in developing countries have internet access. Furthermore, the provision of on-line resources makes information potentially available to an unlimited number of people and it is relatively cost free. Upon saying this, care will be needed in not becoming blinkered to the other ways in which CPD could be delivered, and in reinventing the abundant amount of material already freely available on the internet.

Some useful sources of existing information

One just has to "surf the net" to appreciate the abundant amount of freely available material on the internet. The usefulness of the material will be determined by the user's work background. I will outline some of the sites I find most useful keeping in mind that my area of work is in herd health of sheep and cattle in south-eastern Australia.

Commonwealth Veterinary Association website

The CVA has a website found at <http://www.commonwealthvetassoc.org/>. This provides information regarding the CVA and its activities, as well as links to its journal and upcoming events.

Google

The internet search engine Google found at <http://www.google.com.au/> will give you access to an almost infinite body of information. Some useful features include the link to images, which will give images of any key word entered; similarly, the link to videos; the link to titles and, in some cases, contents of books of any topic; and the link to scholarly articles on any topic.

The Merck Veterinary Manual

The Merck Veterinary Manual found at <http://www.merckvetmanual.com/mvm/index.jsp> is one of the most comprehensive sites covering general veterinary medicine. It is divided into body systems and veterinary disciplines, but perhaps more usefully it contains a search engine, which will take you to any topic specified.

The Poultry Site

The Poultry Site found at <http://www.thepoultrysite.com/diseaseinfo/> gives you access to links to summary articles of all the major diseases affecting poultry. Similar linked sites exist for pigs, beef cattle, dairy cattle, and even fish.

The Veterinary Education and Information Network (VEIN)

VEIN produced by the University of Sydney, Australia and found at <http://vein.vetsci.usyd.edu.au/sheephealth/index.html> gives excellent online notes covering sheep health and production. In a separate section it also gives notes covering diseases exotic to Australia. VEIN is a constant work in progress and over time it will give similar access to other topics.

Dr. John M. King's Necropsy Show and Tell

Dr. John M. King's Necropsy Show and Tell produced by Cornell Veterinary Medicine and found at <http://w3.vet.cornell.edu/nst/nst.asp> gives a library of gross pathology images. The site's most useful feature is to enter the 'Advanced Search' link and then enter key words to give images with a morphological diagnosis of a specified topic.

Vet Lab Manual

The Vet Lab Manual produced by the New South Wales government and found at <http://www.dpi.nsw.gov.au/agriculture/vetmanual> gives information on the submission of samples, the specimens needed by discipline, and the specimens needed and the tests to be run for a wide variety of diseases.

WormBoss

WormBoss produced by Australian Wool Innovation Limited and found at http://www.wool.com/Grow_WormBoss.htm is heavily Australian in its focus; however, it does give useful background information regarding internal parasites of sheep and their treatment, management and diagnosis. Similar sites called LiceBoss and FlyBoss also exist.

Animal Health Australia

Animal Health Australia found at <http://www.animalhealthaustralia.com.au/> contains a variety of useful information. Perhaps most useful is the link to AUSVETPLAN manuals, which, amongst other things, will take you to the disease strategies of 35 diseases exotic to Australia. These are comprehensive documents of some of the world's most significant diseases.

Flock and Health

Flock and Health found at <http://www.flockandherd.net.au/index.htm> gives case notes on veterinary investigations in sheep, cattle and other species by District Veterinarians in Livestock Health and Pest Authorities in New South Wales, Australia.

SciQuest®

The New Zealand Veterinary Association (NZVA) has generously given the CVA access to the New Zealand publications found on SciQuest®. SciQuest® is a fully indexed and searchable e-library of quality New Zealand and Australian veterinary and animal science and veterinary continuing education publications.

As a CVA member, to gain access to SciQuest® will then need to forward your home or work email address to your CVA country councilor with your expression of interest. Your CVA country councilor in consultation with your CVA regional

representative will in turn will verify that you are eligible for the rights available to CVA members before forwarding your email address on to Dr Rahman, CVA Secretary who in turn will forward your email address on to the NZVA. *SciQuest* can be accessed using the address www.SciQuest.org.nz.

WikiVet

WikiVet is a website designed to provide a free, comprehensive online knowledge-base for veterinary students, nurses and graduates world-wide. The project is a partnership between the United Kingdom (UK) veterinary schools, Higher Education Academy and Joint Information Systems Committee (JISC).

Over time WikiVet will cover the entire veterinary curriculum in a similar format to Wikipedia. The content has been authored by veterinarians and veterinary students and is subsequently peer reviewed by subject specialists at veterinary schools in the UK. Access to the site is restricted to the veterinary community.

Wikivet includes a number of components including the undergraduate curriculum of veterinary pathology (WikiPath), anatomy and physiology (WikiAnatomy), blood and immunology (WikiBlood), bacteriology, virology and parasitology (WikiBugs), veterinary pharmacology and therapeutics (WikiDrugs), animal breeds and normal reference ranges (WikiNormal), veterinary epidemiology and veterinary public health (WikiEpi), veterinary nursing (WikiVN) and clinical information (WikiClinical).

Access to WikiVet is available to all CVA members. To apply for an account you will need an email address, the veterinary school you attended and your year of graduation. The WikiMaster will then verify you are eligible and will email a password to your email address. This password can subsequently be used to log on and access the information in WikiVet. WikiVet can be found at www.wikivet.net.

The way forward

In spite of these achievements, the planning and management of the CVA CPD program has been well intentioned and good ideas have been formulated but the approach has largely been *ad hoc*. In attempt to address this deficiency a CVA CPD business plan is being formulated to pave the way forward. CVA members are invited to contribute to this plan.

We are mindful that the ease of access of the material for potential users is critical in ensuring that it is used. People would be quickly discouraged if material was in a form that was not “user friendly”.

Other possible acquisitions

The CVA CPD working group is looking at acquiring membership access for CVA members to other websites including the Centre for Veterinary Education found at <http://www.cve.edu.au/> and the Australian Veterinary Association found at <http://www.ava.com.au/>.

Other examples of unique, valuable information for acquisition include the Secretariat of the Pacific Community paraveterinary training material. Also, the Fiji National University is developing a Diploma in Animal Health programme, which could contain useful material. No doubt there are numerous other examples of similar material from throughout the commonwealth.

A possible specific need is a module or section about leadership and how to influence public policy. The European Union (EU) Better Training for Safer Food has developed a module on this topic. The Masters Course in Veterinary Public Health through the University of Sydney, Australia also places some emphasis in this area.

We should also consider developing an evolving list of active volunteer subject-matter specialists who can be contacted at any time for advice on key issues/problems. This area offers great potential to reach out and harness the width and depth of our commonwealth veterinarians with an interest in international development.

CVA members are welcome and encouraged to put forward ideas for other specific needs and other opportunities.

VetLearn®

Without knowing what else may be available it would seem that the NZVA's VetLearn® could provide the appropriate software on which to base the on-line component of the CVA CPD program. The NZVA and VetLearn® could also be a provider of technology, services and expertise.

Once the CVA CPD website were established, before doing much else, the CVA CPD working group would need to clearly establish the kinds of knowledge and skills most sought after before seeing how to best meet these needs. Without this important step we may find that a great deal of time and energy is put in to procuring something that is hardly used. The CVA CPD working group would be instrumental in procuring appropriate CPD material and in establishing links to other CPD material.

A CVA CPD website would ideally include integration of the following components:

- a customer database – to record CPD activities of individuals and groups
- a content management system – being the basic website framework
- a learning management system – to manage delivery of on-line courses
- an e-publishing system – to manage digital resources
- interfaces with social networking sites – for discussion groups

We would envisage that VetLearn® would require funding but the procurement of material and establishment of links would largely be donated. All of what is proposed are components of VetLearn's® current facilities and could be relatively easily and cost-effectively extended to the uses envisioned, as long as sufficient funding was available to fully cover the time and expenses involved. Costs would depend on the requirements the CVA CPD working group develop, but would not be insubstantial. Although VetLearn® is not-for-profit, it has no source of revenue other than what it can generate directly and all projects must be fully self-funding. With the CVA's financial position as it is, the current budget plan, and the drive to procure funding from other sources, we expect that any necessary funding would come from applications for financial assistance from various donor organisations such as NZAID. This would be the responsibility of the CVA CPD working group.

Conclusion

For the CVA CPD to move forward or otherwise all CVA members need to consider the following questions:

- Do we need to enhance the CVA's CPD program?
- If so, in what ways would you like the CVA's CPD program enhanced?
- Should the CVA acquire the services of VetLearn® or an alternate platform?
- What would you like to see included on VetLearn® or an alternate platform?

Acknowledgements

The CVA CPD would like to thank the NZVA for giving CVA members access to SciQuest® and the UK veterinary schools, Higher Education Academy and JISC for giving CVA members access to WikiVet.

Session 4: The Role Of Women in Alleviating

The Role of Women Livestock-keepers in Poverty Alleviation

Michelo Syakalima

*School of Veterinary Medicine
University of Zambia, PO Box 32379, Lusaka
Zambia*

Agriculture remains the key priority sector in the growth and poverty reduction programme of Zambia. Over 60 percent of the Zambian population derives its livelihood from agriculture-related activities and reside in rural areas. The livestock sub-sector in the country continues to be the main bridge during the crop and non-cropping seasons and is a very key sector in poverty alleviation. Livestock and its products provides ready income for health, education and other immediate needs. It is also recognised that women are very key players in the livestock sector but very little is documented about the extent of their contribution to poverty alleviation. This is in contrast to considerable research worldwide on the roles of women in small-scale crop farming, where their importance is widely recognized and lessons are emerging about how best to reach and support women through interventions and policies.

This presentation therefore looked at three aspects of women in the livestock sector i.e. how women commonly acquire livestock in Zambia, their contribution in the productivity of their livestock and finally their contribution in marketing. The presentation used the example of a smallholder dairy cooperative in the Southern province of Zambia.

Women in that area of Zambia acquire their livestock in two ways which we call traditional ways and through women empowerment initiatives. Under the traditional means, inheritance is the main form of acquisition although other means such as buying of their own livestock is common. The main livestock acquired by inheritance are usually cattle whereas small livestock will mostly be acquired by buying.

Women are also very involved in the production of their livestock. According to the data from the smallholder cooperative, 82% of livestock feeding, 94% of water provision and 90% of milk utilities cleaning is done by women. The rest include 36% of women doing production training courses and only 8% involved in herding the livestock. These figures will obvious vary depending on management systems and type of livestock kept but they give an indication on the levels of involved that can be achieved with proper support.

Involvement in marketing of livestock and livestock products is very cardinal in the realization of poverty alleviation by women. Involvement in markets helps women organise the market process, determine cost of their produce and reduce the cost of production. As data from the cooperative indicates, 95% of women were involved in selling milk and this meant cash came directly to the women. This may vary on the types of livestock and produce to be marketed but the example shows that the potential to empower women on this aspect exists and should be exploited fully.

In conclusion, this study showed that the benefits accrued by women keeping livestock are enormous and have a direct influence on the family's well being. Money which was realised was directly invested on family needs such as: Animal feed and AI charges, milk cans, buckets, cooperative membership fees, school fees and uniform, food, human and animal medicines, repairs or building of new house and kitchen, and others: radio, bicycle, clothes, petrol, paraffin, candles other domestic family needs, air time. These may look small but count a lot in the resource poor communities.

The Role of Women Buffalo Farmers in Poverty Alleviation

Ashoka Dangolla

*Sri Lanka Veterinary Association
Faculty of Veterinary Medicine and Animal Science
University of Peradeniya
Peradeniya 20500
Sri Lanka*

Global Buffalo population, both swamp and river types, approximately 200 million, is on the increase. Buffalo, an efficient crude fibre transformer into draft power and milk, is largely an Asian animal (97%). Its use is gradually shifting from draft power towards milk and more importantly milk products. The distribution of high producing river type breeds, appear to be concentrated only in some countries and also within most range countries, only in certain areas. Countries with long history and established culture, appear to have reared buffalo for longer periods in small farming units with 2-3 animals. In Asian countries, women had a role to play with most agricultural animals, since the breadwinner of the family, is involved in the field on hard agricultural physical work. In countries where buffalo was mostly used for draft in the past, as early as 2nd BC, women had a negligible role to play in buffalo management. Countries with outstanding history of architecture, buffalo had been used to provide draft power in constructions of walls, palaces, religious structures and tanks. Even today buffalo is being used in brick production at rural level, ploughing, harrowing and for transportation. However, most manipulations of the buffalo during such activities is done by men and the role of women is indirect, by providing food and water to animals and to the men who are involved.

With changes in economy, the role of the breadwinner in the family in poor and developing countries, changed and women accordingly had to take over some income generation activities. In Sri Lanka, civil war forced thousands of house wives to earn because their husbands were either injured or died. Women therefore, got involved in agricultural animal husbandry to save time, for better income and at times, for livelihood. In most Asian countries, rural women either directly manage agricultural animals or assist men in managing them (55-70% of rural women in Malaysia, Thailand, India), or handle entire process of milk preservation and processing. Unlike most rural women in India, Thailand and in Pakistan, Sri Lankan rural women do not directly handle buffalo possibly due to its unpredictable temperament and hardness of the teats with compared to cattle. However, entire process between milking and processing it into milk products are largely handled by women. Buffalo, is kept by poor villagers as a financial security too, and when a necessity arises, they are sold.

When the economic demand increases, many women will join in buffalo management. Such activities can be enhanced, if rural women in range countries can be educated on the efficient use of women labor while better producing buffalos with tolerable temperament can be introduced and popularized.

A Practical Project for Poverty Alleviation in Small-Scale Farming Communities in South Africa

Leon de Beer and Gareth Bath***

*National Wool Growers' Association of SA
PO Box 34291, Newton Park, Port Elizabeth 6055
South Africa*

All too often, well-intentioned, properly planned and adequately funded projects to alleviate poverty in rural communities in developing countries fail to produce the envisaged goals. The development project for wool sheep owned by small-scale farmers especially in the Eastern Cape Province of South Africa is a welcome exception to this rule and can serve as a model or example when other projects are envisaged and planned.

The National Wool Growers' Association (NWGA) is a Non-Governmental Organisation that represents the bulk of both commercial farmers (4000 members) and communal farmers (6000 members) and has taken the lead in organising and running this project.

Support from many organisations was and is an essential element of its success.

The target is to make more profit from wool sheep. To achieve this the project's initial goal was to improve the quality and quantity of wool, ensure that shearing, sorting and marketing were optimally achieved, and train farmers in appropriate techniques or skills.

Of approximately 850 communal shearing sheds, the top 300 were targeted by 8 regional advisors for improvement. Facilities, shearing, classing, equipment, disease control and marketing are improved within realistic budgets and the aim is to make the changes self-perpetuating and sustainable. The result has been a very significant increase in income from wool, in many communities by more than tenfold.

Provision of quality rams from nearby Group Breeding Schemes in commercial farmers has helped improve wool quality. Over 5 years 15000 rams have been introduced on an exchange basis. Women have been a significant part of the project with ownership and participation running at over 40%, with youth contributing 30% of inputs.

The project has latterly been expanded to include animal health, especially sustainable, holistic and integrated parasite management. Farmers have taken part in trials that have had an international impact.

The next priority is to improve the reproductive performance and concomitantly the availability of lambs and cull ewes to market for their meat.

* *National Wool Growers' Association of SA, PO Box 34291, Newton Park, Port Elizabeth 6055, South Africa*

** *Department of Production Animal Studies, Faculty of Veterinary Science, Private Bag 04
Onderstepoort 0110, South Africa*

Session 5: Wildlife and One World One Health

Henipavirus in Ghana

Kate S. Baker, Richard Suu-Ire, Alison J. Peel, David T. S. Hayman, Linfa Wang, Christopher C. Broder, James L. N. Wood and Andrew A. Cunningham

*Institute of Zoology
Zoological Society of London, Regent's Park, London NW1 4RY
United Kingdom*

Henipavirus is a genus of RNA viruses within the family *Paramyxoviridae* which comprises Hendra virus and Nipah virus. The natural reservoir hosts of Hendra virus are pteropid fruit bats in Australia, while pteropid bats elsewhere in their range (e.g. Madagascar, South Asia, South East Asia) are reservoir hosts for Nipah virus. Both Hendra and Nipah virus are zoonotic, causing encephalitic disease in human beings with extremely high case fatality rates of between 50% and 80%. Hendra virus spills over into people via infected horses, whilst Nipah can spill over via infected pigs (as occurred in Malaysia and Singapore in 1998/9), or directly from bats into people (as occurs on an almost-annual basis in Bangladesh, with palm wine drinking a recognised risk factor). In India and Bangladesh, human-to-human transmission of the virus, with fatal consequences, has been documented.

There are no pteropid bats in mainland Africa, but the closely-related straw-coloured fruit bat (*Eidolon helvum*) is widespread and populous. Genetic profiling across their range in sub-Saharan Africa indicates that *E. helvum* forms a panmictic (freely interbreeding) population. In Ghana it lives in huge colonies, often of over a million individuals, within both rural and urban areas, including the centre of the capital city, Accra. We examined *E. helvum* in Ghana for evidence of henipavirus infection and found an approximate 40% seroprevalence to a Nipah-like virus in three colonies examined, including the colony in Accra. Our longitudinal studies have shown evidence of henipavirus circulation in bats in Ghana and our wider studies indicate sub-Saharan Africa-wide infection of *E. helvum* with henipavirus.

Human-bat interactions are common in Ghana, such as exposure to urine and faeces beneath roosts and widespread hunting for bushmeat. Although there is still no official report of henipavirus spillover to humans in Africa, there has been no human surveillance for this infection. Also, its symptoms, notably encephalitis, may be being attributed to other causes, such as malaria. Further investigations are required to find out if henipavirus spills over from bats to humans in Africa and, if so, to determine its consequences and the risk factors that drive zoonotic spillover.

The Role of Wild Birds in HPAI Emergence & Spread: Current Research

Tracy McCracken and Scott Newman

EMPRES Wildlife Unit

*The Food and Agriculture Organization of the United Nations, Rome
Italy*

With the recent global spread of highly pathogenic avian influenza (HPAI) H5N1, wild birds have often been implicated as the principle vector in the dissemination of the virus. In examining the data collected from surveys and studies conducted on wild birds and avian influenza viruses we now have a better understanding of the potential role these wild species may play in the long distance transfer of these viruses. It is a well established fact that wild birds, particularly those of the *Anatidae* and *Charadriidae* families are reservoirs for low pathogenic avian influenza viruses. These viruses can become pathogenic when they enter into highly concentrated populations of domestic poultry. Subsequently, the now HPAI viruses can pass back into wild birds, usually resulting in fatality. Experimentally it has been shown that wild ducks can appear to be healthy and shed virus for an average of 4 days. Migrating birds can travel long distances in this time. There have been a few isolated wild birds die offs, Mongolia and Russia 2005/2009 and Europe 2005/2006, that support the case that wild birds can carry the virus over long distance, but surveillance of wild birds has identified few HPAI H5N1 positive healthy birds. If wild birds were the principle vector spreading the disease we would expect new poultry outbreaks to match the timing of wild bird migration across borders, this does not appear the case. Furthermore, if wild birds were the principle cause for the spread of HPAI, we would have expected the virus to reach many more countries globally than the few endemic countries where it is now established. Although it appears that wild birds are not the primary disseminators of HPAI, it is clear that they do play some role in the epidemiological cycle of the disease. Targeted surveillance and through epidemiology studies of both poultry and wild birds in endemic areas and outbreak sites is critical to understand the interface between these species and the risk factors associated with HPAI emergence and spread.

Diagnosis of Bovine Tuberculosis at Slaughter-Houses: Public Health Implications

Osei-Agyemang Bonsu BD Akanmori, GK Aning

*FamilySearch, Accra
Ghana*

Introduction

In 1996, the government of Ghana instituted a programme to promote dairy cattle development and the use of local milk and milk products in southern Ghana. It therefore became necessary that, the prevalence of BTB in cattle in the programme areas be known and measures instituted to prevent human infection with the disease.

A survey was therefore conducted to establish the prevalence of BTB in the project areas. The study established a prevalence of 13.8% of bovine tuberculosis among cattle of two years old and above in the project areas (Bonsu, et al, 2000). Ten out of the five hundred and seventy cattle which reacted positive to the tuberculin test were randomly selected and slaughtered. Although none of the ten cattle that tested tuberculin positive showed any typical lesions of BTB, upon inspection by meat inspectors, all of the ten cattle showed small nodular circumscribed round lesions, 0.01-0.5 cm in diameter and containing a yellowish cheesy material upon incision in the intestines, which were often termed “pimply gut” lesions by meat inspectors. These lesions were attributed to the gut worm *Oesophagostomum* and were often dismissed as of little public health significance.

During the same period, prevalence of BTB reported from slaughter houses/slabs in the project areas ranged from 0.001-0.1 (Monthly report veterinary services (1997). Also, several researchers have reported instances when cattle have reacted positive to tuberculin test but without lesions of tuberculosis at post mortem (Turkson and Boadu 1999, unpublished report, Stumpff et al. 1985, Kazwala et al, 1997). There was therefore the need to establish the risk of infection with *M bovis*.

It was therefore hypothesized that; ***“Pimply gut like lesions found in the intestines of cattle at meat inspection are largely due to tuberculosis and not the gut worm (oesophagostomum) and are missed at meat inspection , posing significant risk to human infection”***.

The General objective of the study was to test this specific hypothesis and to show that pimple gut like lesions found in the intestines of cattle at post mortem are largely due to tuberculosis, but often confused with oesophagostomosis. The specific Objectives were;

1. To identify TB infected cattle using comparative tuberculin test prior to slaughter.
2. To subject the carcasses to routine meat inspection.
3. Carry out detailed inspection of the carcasses for any evidence of BTB
4. To determine the presence of Mycobacterium in the pimply gut like lesions in the intestines of slaughtered cattle.
5. To determine the proportion of BTB lesions that can be confused with pimply gut lesions (gut worm).

Materials and Method

The study was conducted at Accra and Amasaman slaughterhouses in Tema and Ga districts of the Greater Accra region of Ghana respectively. The animals for the study were randomly selected from the Ashaman cattle market at Ashaman, in the Tema District. Individual Farms and the Aveyime cattle ranch, all in the Greater Accra region.

The study was conducted from September 1999 to Jan. 2001.

Study Population and Method

One hundred and fifty cattle were selected from nine hundred cattle (after the nine hundred cattle were tuberculin tested). Seventy five out of the one hundred and fifty had tested positive to tuberculin test, whilst the remaining seventy five were selected randomly from the remaining cattle that tested negative to tuberculin test. The study was double blinded to prevent biases. Both the positive and controls were given coded numbers before slaughter. Each batch of cattle for the study was presented at the slaughterhouses for slaughter without making the Meat Inspectors aware that the animals presented belonged to the experimental lot. This was done to prevent biases.

Before the Animals were presented for slaughter, an assistant took nasal swabs from both cases and controls to be stained and examined for tubercle bacilli. Faecal samples were also taken for examination for oesophagostomum eggs and larvae. All formalities at the slaughterhouses were followed.

An enhanced meat inspection was conducted after the regular Meat Inspectors had completed their inspection. Enhance meat inspection comprised cutting lymph nodes and lungs into slice of about 2 cm and 10 cm respectively. Carefully inspecting the offal for any swelling or granulomas. Deboning of carcasses. Cutting bones into pieces for inspection.

Forty five (45) samples of pimply gut-like lesions, five (5) congested lymph nodes, twenty (20) nasal swabs and forty (40) faecal samples were sent to the Laboratory for bacteriological and parasitological examination.

Results

Meat Inspectors who have been assigned to inspect meat at the two slaughterhouses inspected all the 150 cattle routinely after slaughter in batches. The 150 cattle were also subjected to an enhanced meat inspection. The meat Inspectors passed the carcasses and offal of 147 out of the 150 cattle for human consumption at the first inspection without any comments. The offal of 1 out of the remaining 3 cattle was condemned due to multiple lesions suspected to be tuberculous lesions. About ½ a kilogram of muscle was trimmed from the gruteal muscle of the third animal due to an abscess believed to have been caused by an injection.

During the enhanced meat inspection, small swollen circumscribed round lesions with a diameter ranging from 0.01-0.5 cm containing yellowish cheesy material upon incision, which are often termed “pimply gut “ were found in the intestines of 74 out of the 150 animals presented. The pimply gut-like lesions were also found in the intestines of the cattle that showed Tuberculous like lesions. In all, 75 out of the 150 cattle presented had pimply gut-like lesions in the intestines. After decoding the numbers given to the 150 cattle, it was found that all the 75 cattle that showed pimply gut like lesions also reacted positive to tuberculin test. None of the 75 cattle that reacted negative to tuberculin test had pimply gut-like lesions.

The results of laboratory examinations of the pimply gut like lesions showed the presence of acid-fast organisms in 77.7% of the samples submitted. No acid fast organism was found in the nasal swabs. No oesophagostomum larvae was found in the pimply gut like lesions. The results did not show the presence of oesophagostomum eggs or larvae in the faecal samples submitted.

Discussion

Bovine tuberculosis is transmissible to humans (Crofton 1992, Archa and Szyfres, 1987) and so this high prevalence of the infection in cattle presented for slaughter represents a potential risk to human infection. Studies elsewhere have indicated a high prevalence of tuberculosis due to *M. bovis* in humans in areas where the prevalence of BTB is high (Afredson and skjerve 1993, Archa and Szyfres, 1987).

The present study has shown that whereas the comparative tuberculin test is effective in identifying TB infected cattle; routine meat inspection could identify only one out of the 75 tuberculin positive cattle (1.3%). This means that nearly all cattle infected with *M bovis* are likely to remain in detected by routine meat inspection and the meat could pose a considerable risk to human health.

The findings of the study are in conformity with the findings of Kazwala and others (Kazwala et al., 1997). Ritacco and de de Kantor (1991) reported a similar result in Latin America. Carmichael (1941) in his extensive survey examined

1500 tuberculin positive cattle after slaughter and found out that only 2.5% had tuberculous lesions. In Cape Coast (Ghana) Turkson and Boadu (1999) could not detect any TB lesions in 4 tuberculin positive cattle after slaughter, however pimply gut like lesions were found in all the 4 cattle.

All the studies reviewed above were conducted in developing countries where animals are often kept in free range, a practice which does not favour infections by the aerosol route. In these countries, water and feed for cattle can easily be contaminated by *M bovis*. For example, during the dry season in Ghana, one small pond may serve as the only source of drinking water for several hundreds of animals from different areas. In such a situation, if one infected animal drinks from the pond and contaminates it, many non-infected animals could easily be infected. Also animals with TB lesions in the intestines shed tubercle bacilli in their faeces (Maddock 1936, Bukulove et al 1987). This may contaminate the grazing grounds serving as source of infection for non-infected animals. Non-infected animals may therefore get infected with *M bovis* either through the contaminated grass they pick as they go grazing or through contaminated water they drink.

It is documented that there is direct connection between the route by which an animal get infected with tuberculous bacilli and the location of lesions. If an animal gets infected through aerosol (respiratory route) the primary location of lesions will be the lungs and/or associated organs. On the other hand if the infection was through the mouth (oral route) then the lesions will be in the intestines and/or associated organs (Crofton 1992).

So whilst the respiratory route may be the major route of BTB infection in developed countries where intensive management is practiced (large numbers of animals are kept and fed in an enclosed environment), the oral route may be the most important in developing countries. In the same way, whilst the lungs and associated organs may be the common sites for BTB lesions in developed countries, the intestines and associated organs may be the most common sites of BTB lesions in developing countries.

Although the Mycobacterium present in the lesions were not specifically isolated and identified as *M bovis*, taken together with the comparative tuberculin positive reaction of cattle prior to slaughter to specific antigen of the causative agent of BTB, *Mycobacterium bovis*, and the very strong association between the presence of the lesions and positive reaction to the comparative tuberculin test, it can be concluded that:

1. Cattle with pimply gut like lesions react to tuberculin test.
2. The high percentage of pimply gut like lesions (77.7%) showing acid fast organisms indicate that pimply gut like lesions found in the intestines of cattle at meat inspection are largely due to *mycobacterium bovis* and not the gut worm oesophagostomium spices.
3. The high percentage of tuberculin positive cattle (99.7%) missed by meat inspectors indicates that these pimply gut like lesions are confused with lesions that are caused by *oesophagostomium radiatum*.
4. Since meat can be a source of infection of *M bovis* to humans, this inability of Meat Inspectors to detect BTB lesions poses a significant risk to human infection

The result of this study may offer the major explanation for the absence of tuberculous lesions in tuberculin test positive cattle at slaughter as reported by many researchers.

The diagnosis of BTB at slaughterhouses needs skill and trained eye. Meat Inspectors who are assigned to slaughterhouses must therefore be given formal specialized training in Meat inspection for effective diagnosis of BTB and other diseases.

Conclusion

It can therefore be stated that routine meat inspection at slaughterhouses is not effective in the diagnosis of bovine tuberculosis, posing a significant risk to human infection. The prevalence of BTB is much higher than is reported by meat inspectors and this requires efforts to control or eliminate the disease.

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Social Dimension of Zoonotic Disease in Pets and Exotic Animals

Nancy De Briyne
World Veterinary Association
Rue Defacqz 1 1000 Brussels
Belgium

As modern society is becoming more urbanized, the presence in our households of traditional pets, or even exotic creatures, is increasing in popularity with participation by nearly 50% of the households. The vast majority of these keep classical pets such as dogs, cats, rabbits, small rodents, birds and fish. However, an increasing number of companion animals are exotic and wild animals.

Having pets brings many benefits, such as psychological support, friendship, and even good health practices (exercising or reducing stress), however although uncommon with healthy pets, there are also risks for transmission of zoonotic agents by close contact between pets and their owners. These infectious diseases can be caused by viruses (e.g. rabies, highly pathogenic avian influenza virus,..), bacteria (Pasteurella, Bartonella, Campylobacteriosis, Salmonellosis, ..), fungi or parasites (toxoplasmosis, leishmaniosis, echinococcosis, toxocarosis, ...).

There is insufficient or scattered knowledge of the zoonotic risks associated with companion animal zoonoses and this results in a lack of adequate prevention and intervention options.

An FP7 project will start in 2011 to bring brought together experts and organizations from different fields of expertise, and disciplines in a single interprofessional, interdisciplinary and multisectorial think tank, representing the major relevant stakeholders trying

1. To develop a detailed overview of the role of companion animals as a source of infectious diseases for man and food animals.
2. To identify knowledge and technology gaps in the management of the most important zoonoses transmitted by companion animals.
3. To propose targeted actions that contribute to reducing the risk for infectious disease outbreaks in man and food animals associated with keeping companion animals.
4. To disseminate the results to relevant stakeholders to contribute to the uptake of the proposed actions and to promote risk-awareness in healthy and balanced human/animal relationships.

Avian Influenza Surveillance in Domestic Poultry and Wild Bird-Tema Metropolis, Ghana, 2010

*Danso E Fenteng¹, Ampofo W², Afari E¹, Wurapa F¹, Aryee M³, Koney E³, Yebuah N³,
Chima J¹, Awumbila B⁴*

*Department of Epidemiology
School of Public Health, University of Ghana, Legon
Ghana*

Avian influenza (AI) is an infectious disease of birds caused by influenza type A viruses. Migratory waterfowl - most notably wild water fowls are the natural reservoir of all influenza A viruses. There are 16 subtypes of influenza A viruses, of which H5 and H7 subtypes are the most pathogenic. In April 2007, Ghana reported her first HPAI outbreak in a small scale poultry farm at Kakasunanka in the Tema Metropolis. There were subsequent outbreaks at Sunyani Municipality in the Brong Ahafo and Aflao in Ketu South District in the Volta regions in the same year. All infected poultry farms were stamped out. This study sought to determine the current profile of Avian Influenza viruses in domestic poultry and wild birds in the Tema Metropolis over a one year period and covering the dry and wet seasons.

From May 2009 to March 2010, we administered a semi-structured questionnaire to poultry farmers and conducted a cross sectional study on 1282 field samples involving fresh faeces, tracheal and cloacal swabs from domestic poultry and wild birds from 16 communities in the Tema Metropolis. These samples were then subjected to real-time Reverse Transcriptase-Polymerase chain reaction analysis for Influenza A virus.

All the 1282 avian samples tested, were negative for Influenza A viruses. However, Newcastle disease virus was detected in 8% (5/63) of the farms where birds sampled showed respiratory and nervous signs. Also, adherence by farmers to good poultry management practices and proper bio-security measures was found to be low.

There was no evidence of circulation of AI viruses among domestic poultry and wild birds in the study population, between May 2009 and March 2010. This negative result for AI virus in the study shows that measures taken by poultry farmers and other stakeholders were probably effective. However, Veterinary Services should conduct further education of farmers on good poultry practices and bio-security.

Introduction

Avian influenza (AI) is a disease of viral etiology that ranges from a mild or even asymptomatic infection to an acute, fatal disease of chicken, turkey, guinea fowl, and other avian species, especially migratory waterfowl (Alexander 1982, Hinshaw et al 1980, Beard 1989, Webster et al 1992, Easterday et al 1997, Stalknecht et al 1990). Wild water birds have been identified as natural reservoir host of avian influenza viruses. Generally, the infection is asymptomatic as influenza A virus strains of low pathogenicity co-exist in almost perfect balance in wild water birds (Webster et al 1992, Alexander 2000).

Recently, avian influenza has acquired world-wide attention when a highly pathogenic strain of the subtype H5N1, which probably arose before 1997 in Southern China, gained enzootic status in poultry throughout South East Asia. The H5N1 virus had traversed interclass barriers (Perkins and Swayne, 2003) and had been transmitted from birds to mammals (cats, swine, and humans). Although not an entirely unprecedented event (Koopmans et al 2004, Hayden and Croisier 2005), the substantial number of documented cases in humans, associated with severe disease and several fatalities raised serious concerns about a pandemic potential of the H5N1 strain (Klempner and Shapiro 2004; Webster et al 2006). There are several further lines of evidence suggesting that the H5N1 virus has acquired increased pathogenic potency for several mammalian species. Justifiably,

1 School of Public Health, University of Ghana, Legon, Accra, Ghana

2 Noguchi Memorial Institute for Medical Research, University of Ghana, Accra, Ghana

3 Veterinary Services Directorate, Accra, Ghana

4 Dept. of Animal Science, University of Ghana, Legon, Accra, Ghana

this has caused world-wide public health concern (Kaye and Pringle 2005). Globally, 63 countries have reported AI outbreaks since 2006 to March, 2010 (OIE 2010)

In the African Union/Interafrican Bureau for Animal Resources progress report from May 2007 to February, 2009, it was reported that eleven African countries namely; Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Ghana, Niger, Nigeria, Togo, Egypt, Djibouti and Sudan had been infected since the emergence of AI virus in Africa. So far, there have been 52 reported H5N1 human cases with 23 fatalities in Africa. From March, 2009 to March, 2010, only Egypt reported outbreaks in domestic poultry.

In Ghana, the first HPAI H5N1 outbreak was reported in April 2007 in a small - scale poultry farm at Kakasunanka, near Michel Camp in the Tema Metropolis. This was despite several bio-security measures such as a ban on importation of poultry and poultry products from Southeast Asia, affected European and African countries, disinfection of farm workers and provision of equipments and vehicles to curtail the entrance of the disease into Ghana. AI however, appeared in Sunyani in the Brong Ahafo region and Aflao in the Volta region.

Following the outbreak of AI in Ghana, the Government of Ghana paid compensation to poultry farmers for the birds that were culled. The compensation ranged from 70% to 90% of the market prices for day-old chicks, broilers, cockerels and layers, while table and fertile eggs were paid at rates of 50% and 60% of market prices respectively. In all, a total of 13,391 birds were affected and 36,376 birds were destroyed. The Government paid an amount of 160,000 US dollars as compensation to affected farmers (Veterinary Services Directorate (VSD). Annual reports 2007, 2009). The cost of Veterinary interventions and public education on prevention and control of the disease was estimated at 2 million US dollars. Much of this financial support came from donor partners including USAID and FAO (VSD Annual report 2009).

The objectives of this study therefore were (1) to determine the current profile of avian influenza viruses infection in domestic poultry and wild bird in the Tema Metropolis during the period May 2009 to March 2010. (2) To assess Bio-security procedures and practices on commercial poultry farms, backyard farms and live bird markets in the Tema Metropolis.

Methodology

Study Area

The study took place in the Tema Metropolis, located along the eastern coast of Ghana covering an area of 396 square kilometers. It lies within the coastal savannah zone and has a vegetation of grassland and shrub land. Tema metropolis is flat, rising from the coast to 35 meters above sea level. There are a few *inselbergs* that do not rise more than 65 meters above sea level. Average rainfall is 700 millimeters. It is boarded on the north by Ashaiman, to the south by the Atlantic Ocean, to the East and West by Dangbe West District and Accra Metropolitan Area respectively.

Tema has an estimated total population of 511,459 people according to the 2000 census and less than 10% of the population lives in rural communities (Ghana Statistical Services 2000). Also, it is the major industrial zone of Ghana. It has several communal natural resources such as the Chemu and Sakumono lagoons.

Poultry production in Tema Metropolis could be classified into three categories according to installed capacity, marketing system and level of integration of its operations. These are commercial farms, semi-commercial farms and backyard/village poultry producers. It has an estimated total poultry population of 696,694 according to 2009 VSD annual report. These are made up of 534,852 layer chicken, 100,586 broiler chicken, 40,492 local chicken and 11,930 cockerels. The rest are 4,434 ducks, 2,920 turkeys and 1,480 guinea fowls. The metropolis also, has two poultry hatcheries and four commercial feed processing plants namely; Ghana Agro Food Company, Afariwaa Farms, Central Feed Mills and Glamour Farms.

On animal health services delivery, the study area has one government veterinary hospital and two private veterinary hospitals that provide regulatory, field and clinical services (Figure 1).

Commercial poultry and backyard poultry were sampled from Kakasunanka, Bethlehem, Golf City, Serbepor, Gbetsile, Adjei Kojo, Michelle camp, Saki, Kpone, Kubekro, Zenu and Katamansu. Live bird markets in this study were located at Tema community one, Tema community nine and Ashiaman. Again, all wild birds sampled came from Sakumono Ramsar site.

Study Design

A descriptive and cross sectional study using active avian influenza surveillance approach was conducted. A simple random sampling procedure was used to select communities in the metropolis. Also, using criteria for eligibility based on birds whether apparently healthy or with respiratory signs or gastroenteritis or nervous illness, subjects were conveniently selected for tracheal swabbing, cloacal swabbing and collection of fresh faecal. Mist nets were used to capture wild birds and identification were made before release of the birds. Data were collected by reviewing available farm records. Poultry farm owners, poultry farm workers, poultry traders and staff of Wildlife Division of Forestry Commission were interviewed and a semi-structured questionnaire was administered for data collection.

RNA Extraction

Ribonucleic acid was extracted from samples with the QIAamp viral RNA mini kit 250 (Qiagen, GmbH). RNA was eluted in 40 µl twice with a final product of 80 µl. This was stored in a -700C ultra low freezer thermo scientific at the P3 laboratory corridor, Noguchi Memorial Institute for Medical Research and 8 µl of RNA was used as template for the real time RT-PCR.

Real-Time Reverse Transcriptase-Polymerase Chain Reaction (RRT-PCR)

The Qiagen one step RT-PCR kit (Protocol: Influenza A Matrix gene AB17300 RT-PCR Spackman et al., 2002) was used with a 20 µl reaction volume under the following amplification cycling conditions; 0.8 µl of Qiagen one-step enzyme (Qiagen GmbH), 10 pmol of each primer, 0.3 µM probe, 0.8 µl of deoxynucleoside triphosphate (dNTPs), 1 µl magnesium chloride (MgCl₂), 4 µl of 5X buffer of Qiagen kit, 1 µl of ROX dye working dilution (1:100) and 6.5 U of RNase inhibitor.

The RT step conditions for forward and reverse primer set were 30 minutes at 50°C and 15 minutes at 94°C. A two-step PCR cycling protocol was used for the matrix gene primer set as follows; 45 cycles of 94°C for 0 seconds and 60°C for 20 seconds. The H5 PCR was as follow; 94°C for 0 seconds, 57°C for 20 seconds and 72°C for 5 seconds for 40 cycles. Primers used for this amplification are listed in table 1.

Table 1. PCR primer and probe sequences for Influenza A virus detection

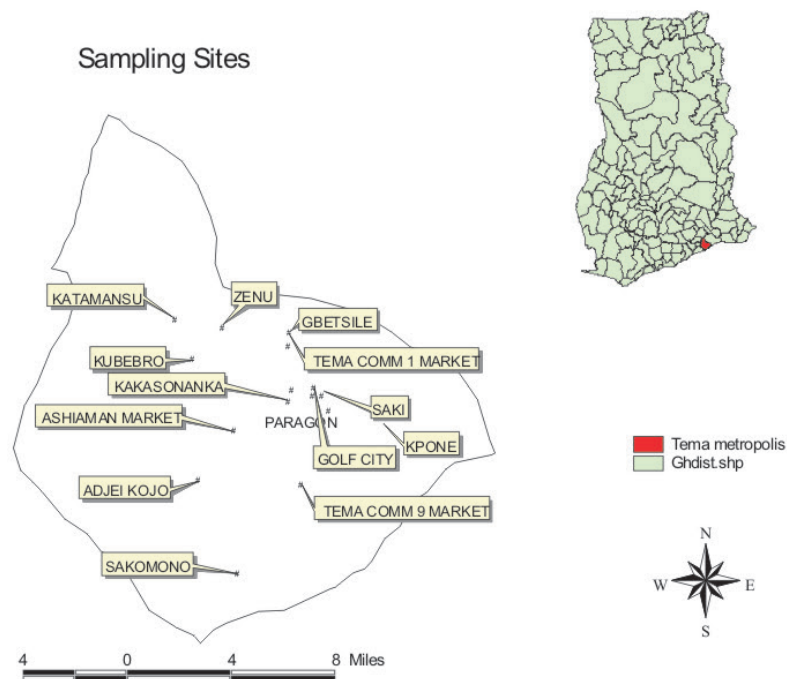


Figure 1. Sampling sites in Tema Metropolis (Source, VSD, 2009)

Specificity	Primer/Probe	Sequence ² (5'-3')
Influenza A virus M + 25		AGA TGA GTC TTC TAA CCG AGG TCG
	M - 124	TGC AAA AAC ATC TTC AAG TCT CTG
	M + 64	FAM-TCA GGC CCC CTC AAA GCC GA-TAMRA
Avian H5	H5+1456	ACG TAT GAC TAT CCA CAA TAC TCA G
	H5-1685	AGA CCA GCT ACC ATG ATT GC
	H5+1637	FAM-TCA ACA GTG GCG AGT TCC CTA GCA-TAMRA
Avian H7	H7+1244	ATT GGA CAC GAG ACG CAA TG
	H7-1342	TTC TGA GTC CGC AAG AC TAT TG
	H7 + 1281	FAM-TAA TGC TGA GCT GTT GGT GGC A-TAMRA

FAM, 6-carboxyfluorescein; TAMRA, 6-carboxytetralrhodamine.

Source: Spackman et al 2002

RRT-PCR was performed by an advanced pathogen identification device called Applied Biosystems 7300 Real Time PCR System. Results of RRT-PCR were determined by the device autoanalysis software with a positive control cycle threshold (Ct) at 20.45 and a negative control Ct at undetectable

Conventional RT-PCR for Newcastle Disease Virus (NDV)

Conventional RT-PCR NDV was performed as described in the field and laboratory manual (Capua and Alexander. Avian Influenza and Newcastle Disease. A field and laboratory Manual. Chapter 11.3). Briefly, the reaction conditions used were as follow; 500C for 30 minutes and 940C for 15 minutes with annealing temperature of 940C for 30 seconds, 550C for 1 minute and 680C for 1 minute on a 35 cycle run with a final extension of 680C for 7 minutes. Fragment size at 270bp

Conventional RT-PCR NDV was by Applied Biosystems 2720 Thermal Cycler.

Primers used for this cycle were as follow;

Primer Forward: NOH-For 5' TAC ACC TCA TCC CAG ACA GG 3'

Primer Reverse: NOH-Rev 5' AGT CGG AGG ATG TTG GCA GC 3'

Results

Descriptive Characteristic of Birds

A total number of one thousand two hundred and eighty two different birds were sampled from 16 different places within 2.5 kilometers to 18 kilometers of the Tema Metropolis. Out of these, 384 samples were from Commercial poultry farms, 393 samples were from Backyard farms, 384 samples were from Tema Community One, Tema Community Nine and Ashiaman live birds markets and 121 samples were from wild birds at Sakumono Ramsar site (Table 2).

About, 91% (349/384) of birds sampled from commercial poultry farms were females while 9% (35/384) were males. The sex distribution of the backyard poultry was found out to be at 72% (283/393) for females and 28% (110/393) for males. Again, the study observed 69% (265/384) females and 31% (119/384) males in the case of the poultry birds in live bird markets. However, all wild birds sampled at the Sakumono ramsar lagoon, sex identification was not done. This was due to the fact that there was no expert to determine the sex of the wild birds. We found out that 15% of the farms sampled had grower age range (less than 18 weeks for commercial birds and less than 24 weeks for backyard birds) and 85% had adult birds (more than 18 weeks for commercial birds and more than 24 weeks for backyard birds) at the time of sampling.

Table 2. Descriptive characteristics of Birds

Count	Percent
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Flock Grouping	Commercial	384	30%
	Backyard	393	30.6%
	Live Bird Market	384	30%
	Wild Bird	121	9.4%
	Total	1282	100%
Age Range	Grower	192	15%
	Adults	1090	85%
	Total	1282	100%
		Male	Female
Sex	Commercial	9%(35/384)	91%(349/384)
	Backyard	28%(110/393)	72%(283/393)
	Live Bird Market	31%(119/384)	69%(265/384)
	Wild Bird	Unknown	Unknown

**Wild birds could not be sexed*

Clinical Findings

The study took into consideration the signs and symptoms associated with Avian Influenza as documented by Capua and Mutinelli (2001) which identified ruffled feathers, marked depression swollen comb, swollen eyes, severe haemorrhages on the shanks, reduction in egg production, weight loss and slight respiratory problems.

In this study, we observed an average mean of 8.4% of the farms sampled had birds with clinical presentations such as marked depression (7.6%), respiratory problems (11.5%), swollen comb (3.7%), ruffled feathers (10.5%) and swollen eyes (8.6%). However, symptoms such as severe hemorrhages on shanks and reduction in egg production were not detected in any of the farms.

It was realized that the highest morbidity rate was 6.7% with p-value of 0.125 at 95% confidence interval and we have sufficient evidence that there was no statistically significant difference so far as morbidity of HPAI H5N1 is concerned. But, it is important as the clinical presentation of Avian Influenza is variable and symptoms are fairly unspecific. (Elbers et al. 2005).

We found out that 13/105 farms sampled, reported mortalities ranging from a high of 27.3% to low of 0.1% (Table 3). These mortality rates were observed on commercial and backyard poultry farms at Gbetsile, Kakasunanka, Saki, Zenu, Kpone and Michelle Camp.

Table 3: Mortality rates (May 2009-March 2010)

Place	Flock Grouping	Mortality Rate
Gbetsile	Commercial Poultry	0.1%
	Backyard Poultry	4.8%
Kakasunanka	Commercial Poultry	0.1%
Saki	Commercial Poultry	1.1%
	Backyard Poultry	2.7%
Zenu	Commercial Poultry	0.2%
	Backyard Poultry	14%
Kpone	Commercial Poultry	0.1%

	Backyard Poultry	4.3%
Michelle Camp	Backyard Poultry	27.3%

Management Practices

In commercial holdings, the study revealed that 91.7% used deep litter while 8.3% had their animals caged. The backyard and wild birds had all the animals scavenging. However, the wild birds covered a large area in search of food. The live bird markets exclusively caged all types of different avian species. This shows that the spread of avian influenza virus in an outbreak is likely to be more devastating in the commercial birds (Capus et al 2000) and wild birds. Feeding and watering activities revealed that 81% of feed was self-prepared while 78% of water was manually administered.

Bio-Security Practices

From the study, we found out that 33.3% of farm houses were disinfected while 66.7% were not disinfected. This portrayed a high percentage of farm houses that did not follow hygienic principles of disinfection thus making the removal of pathogenic materials impossible.

It was observed that the frequency of disinfection of poultry houses varied from one to four weeks (that is 16.2%) for those who disinfected at one to four weeks while 12.4% disinfected between five to eight weeks intervals.

We found also that 22.9% poultry farms had functional footbaths while 77.1% did not have functional footbaths. This shows that a large proportion of farms have the potentialities of AI and other diseases being easily introduced into them, if the movements of people in and out of these farm houses are not controlled.

The study showed that only 20% of the commercial farms had the facilities for vehicular dips while 80% did not have. This also stresses the fact of the possibility of the introduction of diseases from vehicles of unknown origins.

The study revealed that 41% of farm workers used protective clothing and 59% did not use protective clothing. This shows that more than fifty percent of farm workers are exposed to possible infections. Furthermore, these farm workers could also be sources of the spread of avian influenza and other infections.

With regards to the disposal of dead birds, it was found out that the methods used included deep burying (45.7%), throwing out of premises (28.6%), burning (4.8%) and use for animal feeding (1.9%). Nineteen percent made up of backyard poultry and wild birds that died were left to decompose wherever they died.

At the live bird markets and the backyard poultry, the main bio-security practice observed was daily sweeping. Also, the live bird markets are located within the main market and mixing of both healthy and unhealthy birds was a common practice among the poultry traders.

Table 4: Bio-security Practices by Poultry Farmers in the Tema Metropolis (May 2009-March 2010)

Activity	Percentage
Farms with Functional Footbaths	22.9%
Farms without Functional Footbaths	77.1%
Farms with Vehicular Dips	20%
Farms without Vehicular Dips	80%
Use of Protective Clothing	41%
Do not use Protective Clothing	59%

Table 5: Disposal of Dead Birds in the Tema Metropolis (May 2009-March 2010)

Activity	Percentage
Deep burying	45.7%
Throwing out of Premises	28.6%
Left to Decompose	19%
Burning	4.8%
Use for Animal feeding	1.9%

Laboratory Results

All 1282 (commercial poultry, backyard poultry, live bird markets and wild birds) sampled in the Tema Metropolis tested negative for avian influenza virus by the real time RT-PCR assays (Table 6). However, for differential diagnostic purposes, the study also further tested samples which showed clinical signs as described in Clinical findings for Newcastle Disease Virus. Testing conducted for Newcastle virus found 8% of total farms that showed signs as outlined in our clinical findings positive for Newcastle virus (Figure 2).

Discussions

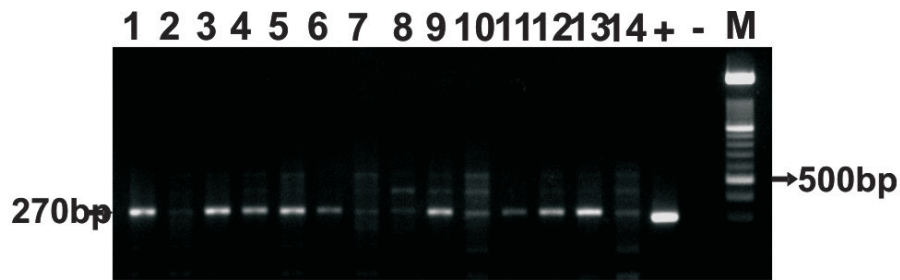
There was no evidence of the presence of AIV among domestic poultry and wild birds' samples in Tema Metropolis which were tested by RRT-PCR during the study from May 2009 to March 2010. The virus had been found in birds in 2007 in an outbreak in Tema Metropolis, especially at Kakasunanka and Adjei Kojo, this result is reassuring in that no avian influenza virus was detected. The study covered only a limited period of time and continuous surveillance will be necessary for early detection of avian influenza virus with potential for avian and human epidemics. It will also be worthwhile to carry out active surveillance in other areas such as Brong Ahafo and Volta regions where outbreaks occurred. Border towns with other countries which have experienced recent outbreaks need to be surveyed as well to have a comprehensive picture of AI profile in Ghana.

It was however, noted that about 8% of the total number of farms sampled were positive for Newcastle disease. Since the symptoms of Newcastle disease and Avian Influenza mimic each other,(Swanyne and Suarez 2000) there is the possibility of Avian Influenza passing for Newcastle disease and vice versa. This could be a problem for an early warning system based on clinical symptoms along as a basis for diagnosis. There is therefore the need to carry out snap laboratory tests for

RRT-PCR Results

Sample	Detector	Ct (cycle threshold)
Positive Control	Flu-A H5 Qiagen	20.45
Negative Control	Flu-A H5 Qiagen	undetected
Commercial bird samples	Flu-A H5 Qiagen	undetected
Backyard bird samples	Flu-A H5 Qiagen	undetected
Live bird market samples	Flu-A H5 Qiagen	undetected
Wild bird samples	Flu-A H5 Qiagen	undetected

Table 6: RT-PCR Results for RRT-PCR for Influenza A virus



Lane-14: Field samples; lane +: Positive control; lane Negative control; and lane M: Molecular Marker (100bp)

Figure 2: Detection of New Castle virus RNA in samples

Note: Required product length is 270 base pair (pb).

Primers used for amplification were derived from I. Capua and D. J. Alexander (A field and laboratory manual. Chapter 11.3)

cases that have symptoms of AI and Newcastle diseases. The situation of negative results for AI in the study area indicate that measures taken by Veterinary Services Directorate supported by USAID, European Union, Government of Ghana and farmers probably yielded positive results (VSD 2009 annual report). However, the husbandry systems practiced by farmers will mitigate efforts to contain the disease should there be an outbreak. Looking at management practices, almost 92% of commercial holdings used deep litter and the rest used battle cages. Studies conducted by Capus in 2000 revealed that birds kept on deep litter are more likely to spread the virus within themselves at a faster rate. The commercial holdings are therefore at a high risk of spreading the disease among birds resulting in high mortality rates and huge economic losses.

Observation of feeding and watering activities revealed that 81% of feed was self-prepared and fed manually to the birds, and 78% of water was manually administered. Analyzing the fact that farm workers are a probable source of introduction of the virus and its eventual spread, these management practices have a high propensity of introducing AI and spreading it within farms. Furthermore, with high demand for manual labour, more farm workers are likely to take part in these activities and therefore, there is a further high risk of introduction and spread from several workers (Capua et al 2003), unlike in automated practices where one person does the job of many.

Bio-security measures differ depending on the type of poultry production system. In some small, medium and large scale commercial poultry farms bio-security measures include fencing or walling of farms, provision of footbath and vehicle dips with constant replenishment of disinfectant solution. Other measures include use of protective clothing by farm workers, hand washing facilities, disposal of dead birds, disinfection of premises and quarantine facility. Conversely, the free range poultry production is characterized by no or minimal bio-security measures (Sonaiya 2007).

Critical analysis of the bio-security situation in the present study area reveals an interesting picture. A review of activities such as the use of protective clothing and deep burial showed that about fifty percent of farmers practiced them. Other activities such as disinfection, footbath, and vehicular dips were practiced by between 20% to 30% farmers. Although there is no baseline for comparing, it was observed that compliance with the use of protective clothing and deep burial were high because these activities cost less and are bought or done once in a while. Other activities which have low compliance rate such as use of footbath, vehicular dips and disinfection of poultry houses required recurrent expenditure especially the frequent use of chemicals which are expensive.

At the live bird markets, sellers did not adhere to any of the requirements of bio-security except for daily sweeping. There is a dangerous practice of mixing different species of birds in the same cage and also mixing sick and healthy birds either together in the same cage or keeping apparently sick birds outside the cage but in close proximity. It was also observed that in the three live bird markets visited, two were within the main markets while one was just a road away on the main market but still within easy reach. One factor to be considered, looking at the scenario, it is possible that buyers will purchase these birds and take them to their homes far and near and could spread infection should there be one especially, if the birds bought are for rearing. The potential for transmission of infection from birds to humans under such circumstances is very high and

poses danger to human health. Bio-security practices in the backyard poultry were mainly daily sweeping. Farmers kept all types of avian species in either poultry pens or in the opened compounds. The risk of infection among birds and humans would also be high could there be an outbreak.

Conclusions

The negative results for AI in the study area indicate that measures taken by poultry farmers in the Tema Metropolis and her development partners during the outbreak in the year 2007 yielded positive result. It also, informs us that the scare associated with HPAI H5N1 infection among poultry farm workers, poultry traders, and veterinarians in particular and the general public is minimal or non-existence.

However, adherence by farmers to good farm practices and bio-security was low as revealed in the study. Commercial poultry farms in the Tema Metropolis generally used deep litter. The backyard poultry or the rural poultry and the wild birds are free ranged. Also, all types of different avian species in the three live bird markets are caged and are mixed up with both healthy and sick birds.

Manual labour is mainly employed in the poultry business and the use of personal protective equipments (PPE) is low since only about 41% of farm workers are using PPE such as wellington boots and overalls only.

In the study, it can be concluded that deep burying of dead birds and throwing outside the premises are the most common methods of disposal of dead birds practiced. Daily sweeping of the premises is the major sanitation practice in the three live bird markets in the Tema Metropolis and traffic control is poor.

There is a need for more intensive and aggressive awareness creation among farmers and the public. It would be still more beneficial if this study could be replicated in other outbreak areas such as Sunyani in the Brong Ahafo and Aflao in the Volta regions to determine the effects of the various interventions.

Acknowledgement

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2. US Naval Medical Research Unit-3, Cairo
3. US Dept of Defense, GEIS, USA

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Lyssavirus Infections of Fruit Bats in Ghana

David T.S. Hayman, Richard Suu-Ire, Marcus Rowcliffe, Kate S. Baker, Andrew A. Cunningham, Anthony R Fooks, Olivier Restif and James L N Wood

*Department of Veterinary Medicine
University of Cambridge, Madingley Road Cambridge, CB3 0ES
United Kingdom*

Bats are reservoirs for many emerging zoonotic RNA viruses, including rabies virus (RABV), SARS-like coronavirus, henipaviruses and filoviruses. Antibodies against Lagos bat virus (LBV; a phylogroup 2 Lyssavirus) have been detected in a population of *Eidolon helvum* fruit bats in Accra, Ghana. *Eidolon helvum* is widely distributed across sub-Saharan Africa where it forms large, dense colonies in close proximity to both man and domestic animals. Satellite telemetry studies have demonstrated that individuals can migrate over 2500 km. It is also a common source of bushmeat in West Africa and was the first species from which LBV was isolated. Whilst RABV is usually fatal in terrestrial mammals, there are increasing reports of antibodies to various lyssaviruses in healthy bats. Phylogenetic analyses also suggest that carnivore RABV had bat origins. We combined observations of wild and captive bats to explore the persistence of LBV in *E. helvum* in Ghana.

We have focused our research on a roost of up to 1,000,000 bats that live in the trees in Accra, Ghana. We used a susceptible-infected-immune (SIR) mathematical model framework to identify key parameters for empirical data collection. Aging bats by tooth cementum-ring annuli examination allowed age-dependent annual mortality rates for juveniles (0.51, 95% confidence limits 0.17-1) and adults (0.83, 95% CI 0.73-0.93) to be estimated using life tables. Birth rates (0.96 young per female per year, CI 95% 0.93-1) and population size changes are also estimated.

A large (~595m³) cage was populated with LBV seropositive and seronegative bats, which allowed quantification of antibody titre decay rates for maternally-derived antibody (half-life 0.63 years, 95% CI 0.42-0.75 years), and infection-induced antibody (half-life 2.17 years, 95%CI 1.88-2.46) in naturally-seropositive adults. Observations determined that LBV transmission is horizontal and is endemic in the population.

Wildlife Conservation in Malaysia: The Current and the Future

Vellayan S

Laboratory Animal Care Unit

*Faculty of Medicine, Universiti Teknologi MARA (UiTM), Shah Alam, 50450 Selangor
Malaysia*

Malaysia consists of 13 states, (2 of the states, Sabah and Sarawak are in the Borneo Island) and 3 federal territories.

The wildlife of Malaysia is one of the most diverse. Malaysia is considered a mega diverse country. Malaysia is covered with tropical rainforest which is 130 million years old and hosts a huge diversity of plants and animal species. There are 210 mammal species, 620 bird species, 250 reptile species and 150 amphibian species. The marine territory also has a great diversity of life.

Of the 210 mammal species in Malaysia, Peninsular Malaysia hold four big cats, namely the Malayan Tiger, the Clouded Leopard, Black Panther and the Spotted Leopard. The large ungulates are the Sumatran Rhinoceros, Tapir, Sambar deer, Gaur, and the Elephant.

Malaysia has a unique primate population, the Bornean Orangutan in East Malaysia, the lesser apes (gibbons and siamangs) and 10 monkey species. The proboscis monkey, the world's largest monkey (langur) is endemic to Borneo.

Of the 625 species of birds, many are endemic to the mountains of the peninsular. Large numbers of Hornbills are seen in East Malaysia. Two thousand fifty (250) reptile species have been recorded, with about 150 species of snake and 80 species of lizard.

The wildlife legislation includes the 3 wildlife Acts namely for peninsular Malaysia, Sabah and Sarawak. Both *In-Situ* and *Ex-Situ* conservations are undertaken. The species includes the Sumatran Rhinoceros, Elephant, Gaur, Tapir, Sambar deer, Barking deer, Mouse deer, Greater Mouse deer, Tiger, River Terrapin, Milky Stork, Pheasants, Hornbills, Slow Loris and False Gharial. This paper highlights the retrospective evaluation of the conservation status of wildlife in Peninsular Malaysia for a five year period (2005-2009). This paper further highlights the *In-situ* and *Ex-situ* development of wildlife conservation in Peninsular Malaysia.

Commercial breeding of wildlife species mainly with the Malayan Porcupine and Lesser Mouse deer started in 2006. Captive bred animal are sold to licensed farmers. Currently there is an increase in number of commercial breeders. The two re-introduction programmes were carried out with the Green Peafowl and Milky Storks. The wildlife conflict management is also highlighted in this study. The department of wildlife and Nation Parks in collaboration with the local Universities and Department of Chemistry has undertaken the molecular genetics work since 2006. This paper will also dwell into the future wildlife conservation in Peninsular Malaysia, in relation to the rapid destruction of forest for sustainable development.

The Urban Crowd: Foraging Ecology of Straw-coloured Fruit Bats (*Eidolon helvum*) from the Non-migratory Subpopulation in Accra, Ghana

Dina K.N. Dechmann^{1,2}, *Richard Suu-Ire*³, *Martin Wikelski*^{1,2}, *Jakob Fahr*⁴

Wildlife Division of the Forestry Commission

Accra

Ghana

Eidolon helvum is one if not the most abundant African mammal as well as a key seed disperser and long-distance migrant, but details of the long- and short-distance movements remain largely unknown. We followed the nightly foraging movements of seven individuals when the majority of bats had left Accra for their yearly migration. We recorded high accuracy locations and acceleration data with miniaturized GPS-loggers. All bats foraged almost exclusively on introduced and/or cultivated fruit, especially neem (*Azadirachta indica*), but also papaya, mango, oil palm and banana. Only two individuals included wild figs in their diet. All bats performed highly stereotypic foraging flights (up to 4 nights per individual). Even though distances of up to 37 km from the roost were covered (mean 18.6 ± 11.8 km), all except one bat foraged in urban or suburban surroundings, sometimes flying over forest to get there. Given the large body size of the bats (285–325 g), foraging areas (excluding roosting and commuting locations) were surprisingly small (core area: median = 3.9 ha, range 2.3–4.9 ha, 50% kernel density; foraging area: median = 23.9, range = 9.9–52.9 ha, 95% kernel density). In fact, the core area usually encompassed only a few food trees. Acceleration data revealed rather short foraging periods, with bats frequently returning to the roost at 2:30–3:00 (12.3 ± 6.2 % flying, 15.3 ± 7.2 % climbing or otherwise active on tree). We speculate that *E. helvum* may increasingly cover its energetic requirements from human-generated resources and thus not all individuals may need to migrate to follow the fruiting trees during the rainy season. State-of-the-art GPS technology, which yields data accurate enough for the identification of individual food trees, will help to shed more light on this important bat tracks spatio-temporal fluctuations in resource availability.

¹ *University of Konstanz, Department of Ornithology, Konstanz, Germany*

² *Max-Planck Institute for Ornithology, Radolfzell, Germany*

³ *Wildlife Division of the Forestry Commission, Accra, Ghana*

⁴ *University of Ulm, Institute of Experimental Ecology, Ulm, Germany*

Session 6: Rabies Workshop

A Blueprint for Canine Rabies Control

Tiziana Lembo and Deborah Briggs***

*Global Alliance for Rabies Control
Manhattan, Kansas 66506-5705
USA*

The Blueprint for human rabies prevention and canine rabies elimination is an online document aimed at helping countries where rabies is present to begin implementing rabies control programs to reduce the number of human rabies cases and potentially to eliminate rabies from an area. The Blueprint is also aimed at providing assistance to countries where rabies has been recently reintroduced. Part I of the Blueprint focuses on how to strategically develop and implement an intersectoral program to eliminate dog rabies while preventing human rabies. It was developed by international rabies experts and stakeholders that belong to the informal group Partners for Rabies Prevention and includes information and weblinks to documents and recommendations by international public health organizations. The Blueprint also includes case examples of existing programs from various countries throughout the world. It provides information on the infrastructure needed to set up canine rabies control programs, national laws that are helpful to help control dog rabies, the costs involved in conducting vaccination campaigns and potential sources of funding. Additionally, the Blueprint contains precise instructions on how to develop and implement a Communications plan for increasing awareness about how to prevent human and control canine rabies. The Blueprint for rabies control is freely accessible on line at: www.rabiesblueprint.com and is currently available in English and French. Translations will soon be available in Russian, Arabic, Spanish and Portuguese. Part II of the Blueprint, that will provide information on wildlife rabies control, is currently under construction.

* *University of Glasgow, United Kingdom*

** *Global Alliance for Rabies Control, Manhattan, Kansas 66506-5705 ,USA*

Rabies Still Kills to many Humans - Overview Africa

Lucille Blumberg and Jacqueline Weyer

*National Institute for Communicable Diseases
National Health Laboratory Service
South Africa*

Rabies in humans is a neglected public health problem despite having the highest mortality of any infectious disease and being preventable. Rabies is generally appreciated as an animal disease, but in fact it is one of the most significant viral zoonoses of all time and continues to affect tens of thousands of people worldwide. The burden is considered high in the developing world – most notably the majority of countries in Africa and Southeast Asia, where dog rabies control is generally nonexistent or completely inadequate. Considering the established availability of effective prevention strategies in humans and control strategies in vectors and reservoirs of the disease, the expansion of the rabies problem over large areas of the world emphasizes the seriously neglected state of this disease. Successful elimination and/or control of rabies in dogs and several other wildlife vector species in many regions around the globe including the United States of America, Canada and Western Europe have been founded on strategic and innovative use and delivery of vaccines. The drastic decrease in the number of dog rabies in Mexico, (considered a developing country) in recent years, once again through adequate vaccination and population control strategies, begs the question why these successes have escaped the greater continent of Africa?

A major factor is a lack of surveillance accurate data on the true public health impact of the disease especially in Africa. It is generally accepted that the number of deaths officially reported in most developing countries greatly underestimates the true incidence of rabies disease, which leads to lack of attention by national authorities in much of Africa and Asia, and by the international organizations concerned. Extrapolated data and estimations from a linked epidemiological and economic model showed that human mortality from endemic canine rabies was estimated to be 55 000 deaths per year with 56% of the deaths estimated to occur in Asia and 44% in Africa. The majority (84%) of these deaths occurred in rural areas. Deaths caused by rabies were estimated to be responsible for 1.74 (90% CI: 0.25-4.57) million disability-adjusted-life-years (DALY) lost each year. The annual cost of rabies in Africa and Asia is estimated at US\$583.5 million.

Disparities in the affordability and accessibility of post-exposure prophylaxis, levels of rabies awareness and risks of exposure to rabid dogs result in a skewed distribution of the disease burden across society, with the major impact particularly on children in poor rural communities. Patients often access only traditional medicine and often die at home with their deaths not recorded as due to rabies. There is frequent misdiagnosis in hospitals and health facilities because of atypical clinical presentations, and a low index of suspicion for rabies in patients with encephalitis especially in communities with high burdens of malaria, TB and HIV-related central nervous disease. In a prospective clinical study of central nervous system (CNS) infections and cerebral malaria in Malawian children, rabies encephalitis was shown to be an important cause of death. Overall 14 (10.5%) of 133 children who died from suspected CNS infections had rabies. Rabies in 4 children with no hydrophobia or aerophobia was not diagnosed until brain material was examined. In 3 of these 4 children cerebral malaria had been diagnosed. Overall 11% of deaths initially attributed to cerebral malaria was actually due to rabies virus. Laboratory confirmation is frequently not considered or not available. Lack of access to diagnostic tests, the gold standard specimen requiring examination of post-mortem brain tissue, and the need for relatively specialized techniques and equipment add to the low rate of confirmation in suspected cases.

Rabies was confirmed as the cause of an outbreak of fatal encephalitis in northern Limpopo Province, South Africa, in 2005. This followed an outbreak of rabies in dogs which was confirmed to have originated in Zimbabwe. Human rabies had not been confirmed in the area for more than 20 years and clinicians failed to recognize human rabies cases and misdiagnosed instead viral encephalitis, typhoid, panic attacks, poisoning and polio. Failure to elicit a history of animal exposure and atypical presentations due to traditional healer consultations and medication, negatively affected the differential diagnosis. Overall, 11 cases of rabies had been missed of the 31 human cases eventually diagnosed, confirming that misdiagnosis is common, especially if there a low index of suspicion and overlapping clinical features with other diseases. Intersectoral collaboration between human health and animal health practitioners resulted in a programme to improve community awareness of dog bite management, health worker education regarding PEP and rabies diagnosis, provision of rabies vaccine and immunoglobulin in health facilities. The outbreak provided a major incentive to improve on dog vaccinations in the area.

The majority of rabies-exposed persons in Africa die as a result of failing to access post-exposure prophylaxis. Vaccine and immunoglobulin shortages are frequent, the schedules are complicated and require multiple visits to health facilities, and the costs of biologicals often have to be borne by patients themselves, as well as the indirect costs involved in travel to a health facility. These result in failure to receive PEP, delays in administration and poor compliance with regimens. Wound cleaning is an effective strategy that should be widely promoted to communities as a way to reduce rabies infection. Assessments of the rabies burden in selected countries as well as globally, to promote the development of alternative technologies, such as the intradermal route for post-exposure prophylaxis are critical. This alternative to widely used intramuscular regimens present not only cost saving but also a saving in the amount of vaccine required for a complete schedule. In addition, studies are investigating the efficacy and use of simplified intradermal regimens that would also address the patient compliance issues experienced with the requirement of administration of vaccines on different days over a couple of weeks. It is generally believed, that a universal switch to intradermal delivery of vaccine would improve the affordability and accessibility of PEP for bite victims, leading to a likely reduction in human rabies deaths as well as being economical for health providers.

Laboratory confirmation of rabies has for decades been achieved through fluorescent antibody testing on brain impression smears. This technology presents a long-standing, tried and tested method. Nevertheless development of the direct rapid immunohistochemical test for rabies diagnosis present a similarly sensitive but even a simplified testing protocol which should be achievable with even basic laboratory infrastructure. Development of this assay addressed one of the major factors hampering the wide scale use of the fluorescent antibody test in many settings, the availability of well maintained fluorescent microscopes. Rapid immunodiagnostic, lateral flow assays for detection of rabies antigen in brain specimens have similar sensitivity than fluorescent antibody test and could provide an alternative diagnostic method in the field or where laboratory infrastructure does not allow for any of the other recognized tests to be performed. Unfortunately, this need for brain tissue is quite challenging as there is limited skill in obtaining such a specimen and religious and cultural beliefs often exclude invasive necropsies from being performed. New approaches are desperately needed in resource-limited areas that are less invasive, rapid and sensitive, and affordable. Examination of ante mortem saliva specimens by molecular techniques is one initiative that can be considered more routinely. A reliable diagnosis of human rabies based on analysis of skin biopsy specimens through thin sectioning and fluorescent antibody staining or molecular techniques provides another option and presents a considerably less invasive specimen than brain tissue sampling.

A one-health approach where animal and human health professionals work closely together is crucial to reduce human mortality due to rabies with the major focus being on effective rabies control in dogs.

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Rabies Control in India: Present Perspectives and Future Prospects

Sudarshan M.K

Rabies in Asia Foundation

Department of Community Medicine

Kempegowda Institute of Medical Sciences, Bangalore 560 070

India

In India, annually about 20,000 persons are estimated to die of rabies and this constitutes about 36% of the global burden of the disease. The principal reservoir and vector of the disease (97%) is the dog. The disease is not notifiable in humans and in the animals it is of low public health priority. An estimated 17 million animal bites is known to occur annually. The mainland is endemic and enzootic for rabies and the islands of Andaman and Nicobar and Lakshadweep are known to be historically rabies free. Besides the islands of Lakshadweep are free of dogs.

Till 2004 the nerve tissue vaccine (Semple vaccine) formed the main stay of rabies vaccination in humans. However, from 2005 the country has switched over to modern rabies vaccination. In animals the tissue culture rabies vaccines are widely used. The country is indigenously producing the modern rabies vaccines and equine rabies immune globulins for humans and importing human rabies immune globulins. However, there is both indigenous production and import of modern rabies vaccines for animals in the country.

There is no national rabies prevention/control programme either for humans or animals. As health is a state subject, each province/state has its policy for rabies prevention and control both for animals and humans. The central / federal government broadly provides guidelines and assistance periodically. The lack of intersectoral coordination and cooperation between medical and veterinary sectors and a low priority for the disease are largely responsible for the endemicity and enzooticity of the disease in the country. Since 2001, following the enactment of animal birth control rules for management of dog population in urban areas, the civic / municipal bodies are implementing the animal birth control programme which has often come in for scathing attack by the general public. An independent and external evaluation of the programme is needed to know its effectiveness and acceptability by the people.

Nongovernmental bodies like professional associations viz. Indian veterinary association, Association for Prevention and Control for Rabies in India, Rabies In Asia Foundation, Commonwealth veterinary association and others are supporting and supplementing the initiatives of the Government. The Government of India's initiative of implementation of intradermal rabies vaccination (2006) & pilot project on human rabies prevention in five cities (2008), Adopt a village project of RIA Foundation(2009)and the recent initiative of Indian council of medical research of establishing a task force (2011) for rabies research are encouraging and noteworthy. Lastly, there is a perceptible decline in the rabies mortality in the humans in the recent years and a reassessment of the disease burden is now under consideration.

Role of Education in Human Rabies Prevention

Deborah J Briggs, Peter Costa, Louise Taylor, Kim Doyle

*Global Alliance for Rabies Control
Manhattan, Kansas 66506-5705
USA*

Lack of educational awareness on all levels of society is one of the basic reasons why humans still die of rabies despite the availability of effective rabies biologicals and yet, rabies education is one of the most effective and least costly methods to prevent human rabies. Lack of educational awareness about how to prevent rabies includes dog bite victims not seeking PEP in a timely manner for many reasons including the cost, distance to secure vaccine, and the fact that they simply do not know that they need to receive vaccine. Rabies experts from around the world are working together to overcome these obstacles by improving educational awareness on a global level. The first major campaign to improve awareness was World Rabies Day, launched in 2007. The annual activities of WRD have enabled educational messages to be sent to more than 150 million people in more than 135 countries. WRD has also served as a focal point to vaccinate more than 4.6 million dogs. It has brought people together despite different languages, customs, and religions to spread the message about how rabies can be prevented and controlled. More than 300,000 visitors have logged onto the WRD website (www.worldrabiesday.org) since it was launched in 2007. A recent global survey indicates that more than 96% of respondents believe that rabies education is saving lives and 89% indicated that WRD is making a difference. Further, the Global Alliance for Rabies Control and the Partners for Rabies Prevention have established the largest e-communications network for rabies prevention that has ever existed. From this data base, we are able to tailor our messages to reach those that need specific information on advances in rabies prevention and do so in lightning speed and at very little cost.

Cost Effective Post Exposure Regimens for Resource Constraint Developing Countries

Madhusudana S.N

WHO CC for Reference and Research on Rabies

Department of Neurovirology

National Institute of Mental Health and Neurosciences (NIMHANS)

Bangalore 560029

India

Rabies is a major public health and veterinary problem in most developing countries of Asia and Africa. Globally about 55,000 people die of rabies every year out of which 30,000 die in Asia and 24,000 die in African continent. However, this disease is almost 100% preventable if the state of the art modern prophylactic measures including vaccines and immunoglobulins are administered as soon as the exposure has occurred. The present day modern cell culture vaccines are not cost effective for the resource constraint developing countries if the conventional IM schedule of 5 doses is followed. In order to make rabies vaccination more economical and affordable, efforts were initiated as early as 1985 to develop intra-dermal route of vaccination using one tenth the volume of the IM dose. Several clinical trials in different parts of the world proved that this intradermal rabies vaccination (IDRV) is safe, immunogenic and efficacious in preventing rabies. The IDRV was approved for use in developing countries by the WHO in 1992 and guidelines were established in 1996. Today many countries of Asia such as India, Thailand, Sri Lanka and Philippines have adopted this IDRV and millions of people have been vaccinated with out any treatment failure. Though initially the WHO recommended a 2 site ID regimen (TRC regimen) and a 8 site regimen (Oxford regimen), presently the schedule of vaccination followed is the updated Thai Red Cross (TRC) regimen and vaccines recommended for this purpose are the Purified Chick Embryo Cell Vaccine (PCEC) and Purified Vero Cell Rabies Vaccine (PVRV). The cost of vaccination can be reduced almost by 60-70% depending on the brand of vaccine used. The IDRV has also been found to be good for children and is most economical for pre exposure prophylaxis. However, the IDRV will be more useful in large clinics and hospitals where at least 5-10 patients of dog bite victims attend. Rabies is still a huge burden in African countries. Many countries have now launched national rabies control programmes and modern cell culture vaccines are being used. It is right time for the countries of Africa to adopt IDRV, conduct some pilot studies in African population to know the immunogenicity, reactogenicity and feasibility and eventually replace highly expensive IM regimens with cost effective IDRV.

Session 7: Food Safety and Security /

Food Safety and Security in the Pacific

Kenneth Cokanasiga

*SPC Animal Health and Production Services
Secretariat of the Pacific Community
Private Mail Bag, Nabua
Fiji*

Indicators of Availability and Vulnerability

In 1996, countries at the World Food Summit agreed that:

‘Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy lifestyle.’

Pacific Island Countries and Territories (PICTs) are small and isolated geographically remote, have limited arable land with a relatively narrow natural resource base, and subject to regular natural disasters.

In addition, due to their small economic sizes, the smaller nations are more susceptible to economic shocks.

They however have strengths in their communities having very strong social togetherness, and, despite the above difficulties, have managed to avoid acute food shortages, and been able to withstand the challenges being faced.

Most PICTs are showing increasing and significant rates of dependency on imported foods. Knowledge of traditional farming practices and food preparation techniques is diminishing as people move from rural to urban areas and enter into formal employment and rely less on their own production and more on purchased foodstuffs.

Population pressures are also increasing the demand for food. The increasing rural to urban drift, combined with limited household incomes for these families is adding to their food security problems. Even though remittances are contributing back into the local economies, opportunities for increased economic activities for the small resident local populations are very limited.

Climate change has the potential to further threaten domestic production.

The region has not been isolated from the global food ‘crisis’. The price of imported food products such as grains, meat, dairy and vegetable oil have all risen sharply. For example, in Solomon Islands, the price of imported food increased by 26% over the first six months of 2008, in Fiji this has risen by 117% in 2008 compared to 2007.

In the Melanesian region subsistence food production is still the most important source of food, with a small but growing proportion of local household surplus marketed. This is especially so for rural dwellers. The proportions are a lot less for the Polynesian and Micronesian countries.

When analysing the nutritional components that come from local and imported food, for PNG, 83% of its food energy requirements is from locally grown food with 17% from imported foods. Locally grown foods contribute to a lower 17% of its protein requirements. The Solomon Islands imports 21% whilst Fiji imports 58% of its food energy needs and 60% of its protein needs.

Smaller atoll countries such as Pohnpei import 73% of their food energy needs and 64% of their protein requirements.

When analysing the amount of food imported compared to the total imports, for the larger Melanesian countries, these range from 7% for PNG, 17% for the Solomon Islands, 14% for Vanuatu and 14% for Fiji. These have remained relatively constant over the recent years and could be due to increasing preference for local foods or a general increase in both local and imported food items.

Compared to the smaller Polynesian and Micronesian countries the figures are generally higher around 30% for Tuvalu, Tonga and Samoa, and increasing. Is this an indication for preference for imported food items?

Another indicator for a country's food security is its ability to pay for its food imports. FAO had developed the Food Capability Index (FCI) to measure a country's food security vulnerability. It measures the proportion of the value of food imported to the total value of imports. An FCI of more than 0.5 puts a country in a vulnerable state, whereas an FCI of more than 1.0 makes a country highly vulnerable. Examples of the average FCI's for PICTs 1990 to 2001 range from Solomon Islds (0.15), PNG (0.12), Fiji (0.17), Tuvalu (5.43), Samoa (2.59), and Niue (1.32).

When a country's remittances, and ability to service its foreign debt is also taken into account, an FCI "Plus" indicator is measured. These factors do affect the food security vulnerability (FCI plus) a country. For the above countries, the FCI plus index range from PNG (0.15), Fiji (0.14), Solomon Islds (0.12), Samoa (0.46), and Vanuatu (0.19).

Looking at Household level income as a basis for food security, in the face of rising global food crisis, there are three main groups. Those those are worse off, those that have gained from this, and those essentially unaffected.

Unaffected households include people in rural areas that live outside the cash economy. Those that have gained are households involved in the production of export crop commodities such as copra and cocoa which are fetching higher prices, and, households that are worse off include those low income earners in urban and peri-urban area and squatter settlements.

As the prices of imported food items increase, households are often forced to purchase more locally grown food, or purchase cheaper, but nutritionally poor, imported food items. This further contributes to nutritionally related health problems.

Exopolysaccharide Production in Biofilm of *Listeria monocytogenes* Isolates along Soft Cheese ('wara') and Yoghurt Processing Lines

Adetunji V.O and Arigbede M.I

Department of Veterinary Public Health and Preventive
Medicine University of Ibadan, Ibadan
Nigeria

Virulence of food processing relevance in bacteria isolates are determined by the measurement of several factors such as; biofilm production, adherence factor and exopolysaccharide production. The ability of bacteria to form biofilm has been suggested to play a vital role in the pathogenesis of numerous bacterial species. *Listeria* count and Identification of *Listeria monocytogenes* (*L. monocytogenes*) was assayed along the processing lines of yoghurt and wara cheese. Quantifications of biofilm formation and exopolysaccharide production by 31 *L. monocytogenes* isolates from soft cheese and yoghurt processing lines were assessed at 24 and 48 hours incubation. Biofilm formation was assessed on glass vials surfaces while exopolysaccharide production was assessed for a 10ml broth culture and expressed in μ in 10^6 cfu of cells. *L. monocytogenes* was isolated at all the processing stages of the two products. *Listeria* counts were in the range of 2.72×10^6 - 3.36×10^8 and 5.02×10^7 - 2.0×10^9 respectively for 'wara' and yoghurt processing lines. These counts exceeded international limits. All the strains produced biofilm and exopolysaccharide at 24hr and 48hr incubation. Biofilm and exopolysaccharide production increased with incubation time in 14 out of the 31 strains. R^2 values obtained were 0.002 and 0.125 respectively for biofilm and cellulose production at 24 and 48 hr incubation (P - values of < 0.05). A weak positive correlation ensued between biofilm and cellulose production at 48hr incubation ($R^2 = 0.125$). The isolation of biofilm forming *L. monocytogenes* at all the processing stages of the two products and high counts is of public health significance. Furthermore the ability of different *L. monocytogenes* strains to form biofilm and produce exopolysaccharide may be an important factor in the development of persistent strains within a food processing environment. The development of effective strategies to minimize the incidence of food borne illnesses caused by adhesion of bacteria on food contact surfaces is therefore important. Further studies on the use of sanitizers in biofilm control are therefore necessary.

Keywords: exopolysaccharide, *Listeria monocytogenes*, biofilms, yoghurt, 'wara' cheese

Introduction

Listeria monocytogenes is a food-borne pathogen of serious public health concern. It is included in the World Health Organization's list of foodborne pathogens (WHO, 2002). This pathogen causes listeriosis, an illness that may result in encephalitis, septicaemia and abortion in humans and animals (Jeffers et al., 2001). Listeriosis is the disease that is caused by *Listeria monocytogenes* and is contracted through the consumption of contaminated foods (Taormina and Beuchat, 2002). Although the incidence of foodborne listeriosis is low, it accounts for only 0.02% of foodborne illness per year and is responsible for 27.6% of resulting deaths (Mead et al. 1999). *L. monocytogenes* is widely distributed in nature and has been isolated from a wide array of food products (Kalmokoff et al 2001). *L. monocytogenes* has been implicated in wide range of foods such as salads, seafoods, meat, and dairy (Schlech, 2000).

West African soft cheese 'wara' is a soft, white unripened cheese in West Africa (Adegoke et al., 1992). West African soft cheese contained 70.5% moisture, 39.00% fat, 37.08% protein and 2.53% as reported by Alalade and Adeneye (2006). An earlier study by Adetunji et al., (2003) recorded a 20% isolation rate of *L. monocytogenes* in a local cheese, wara. In other parts of the world, sporadic cases of human illness caused by *L. monocytogenes* listeriosis has been attributed to the consumption of soft cheeses such as the Mexican-style cheese (Linnan et al., 1988) and Vacherin Mont d'Or soft cheese (Bille, 1990; Margolles et al., 1996). The survival of *L. monocytogenes* and its contamination in several soft cheeses have also been investigated (Frank and Marth 1978; Farber et al., 1987; Papageorgiou and Marth, 1989; Kovincic et al., 1991; Back et al., 1993).

Biofilms are architecturally complex communities of micro-organisms in which the cells are held together by an extracellular matrix typically containing exopolysaccharides (EPS), proteins and even nucleic acid (Costerton et al., 1995; Jay, 2000). Biofilms have the ability to readily form in the food industry environment because of the availability of water,

nutrients and surfaces for attachment (Gibson et al., 1999, Midelet and Carpentier. 2004). This is a problem in the food industry because the hygiene of the surfaces affects the overall quality and safety of the food product (Hyde et al., 1997., Gibson et al., 1999). The transfer of attached bacteria to a food product can lead to food spoilage or the transmission of diseases (Cayley et al., 1984, Sharma and Anand 2002). Numerous studies have shown that *L. monocytogenes* is capable of adhering and forming biofilm on metal, glass or rubber surfaces (Hood and Zottola 1997; Wong 1998; Sommer et al. 1999; Chae and Schraft 2000, 2001; Leriche and Carpentier 2000).

Cellulose is an exopolysaccharide produced by microbial cultures and are involved in cell adhesion and biofilm formation. Extracellular polysaccharide (cellulose) for some strains is the polymers that may also influence adhesion (Abu-lail et al., 2003). Lignin, hemicellulose and xylosans are other products from a microbial culture which can be extracted with acetic-nitric acid reagent. Cellulose remains dissolved in H_2SO_4 and is determined by anthrone reagent (Updegraff, 1969). It is also reported as a second component of exopolysaccharide matrix (Roßmaling, 2002., Roßmaling et al., 2003). Some bacteria synthesize cellulose in the form of fimbriae that attach the bacterial, and dextran, which is also synthesized by bacteria as a storage product for carbon and energy, resemble cellulose in some ways (Nester et.al., 2004). The production of cellulose and curli by *E. coli* leads to a matrix of tightly packed cells covered in a hydrophobic network. This network of material is important in biofilm formation as well as in its persistence on various surfaces (Cookson et al 2002).

Therefore, the aim of this study was to evaluate the relationship between the biofilm formation and cellulose production by *L. monocytogenes* strains isolated along the processing lines of West African soft cheese 'wara' and yoghurt.

Materials and Methods

Microbial assay

Listeria Count

Samples were taken at each step of processing for 'wara' cheese (raw milk (Rm), addition of coagulant (Ac), curdling point (Cp) and cheese in mould (Cm) and for yoghurt (powdered milk (Pm), pasteurization (Pt), inoculation of starter culture (In), fermentation (Ft) and finished product (Fp). At each sampling, 1 ml/1 gm of sample was aseptically drawn. Solid samples were then homogenized in 10 ml 0.1% sterile peptone water in stomacher bags using a Stomacher 400 lab blender (Seward Ltd., London, UK). Serial dilutions were made in sterile 0.1% peptone water to 10^{-4} dilution for all samples except the finished products which were to 10^{-6} . Appropriate dilutions were surface plated on modified oxford (MOX) agar (fishers scientific, USA) supplemented with antibiotic supplements (acriflavine, nalidixic acid and cycloheximide) (Becton, Dickinson and company) for the enumeration of *L. monocytogenes*. All of the plates were incubated at 37°C for 24 h. Enumeration was done using a colony counter (Model 3325, Leica Quebec Dark Field, Buffalo, NY, USA). Colonies on each agar plate were expressed in colony forming unit per ml (cfu/ml/gm).

Preparation of bacteria cultures

Thirty *L. monocytogenes* strains from 'wara' cheese (20) and yoghurt (10) were confirmed according to methods by Barrow and Feltham (1993) along processing the processing lines. Cultures were purified by sub-culturing 3 times on Modified oxford Agar (fishers scientific, USA) for Listeria isolation supplemented with antibiotic supplements (acriflavine, nalidixic acid and cycloheximide) (Becton, Dickinson and company). Specific antisera (fishers scientific, USA) were used in confirming *L. monocytogenes*. Positive coagulation reactions were observed with *L. Monocytogenes* polyserotype antiserum in broth cultures of the test inoculums. A known *L. Monocytogenes* strain was used as a control.

Biofilm formation quantification

Preparation of culture

One colony of each *L. monocytogenes* culture was transferred into 9ml of tryptose soya broth. The inoculated broths were then incubated at 37°C for 24 h. These broth cultures were used for biofilm formation on glass surfaces. The uninoculated tryptose soy broth was used as a negative control.

Attachment on glass surface

Glass vials (4.5 X 1.4 cm; Fisher Scientific) were used as glass surface. The glass vials were washed with alkaline detergent (Unilever, Nigeria), rinsed thoroughly with deionized water, and air-dried before being autoclaved at 121°C for 30 min. Three millilitres of each broth culture was placed in each glass vials. The *L. monocytogenes* culture was allowed to attach to the glass surface for 24 and 48 at 37°C. The tryptose soy broth not inoculated with *L. monocytogenes* was used as negative control throughout the study. Approximately an equal population of cells of each culture was used. Lids were placed on glass vials to prevent evaporation of the broth. At the end of each day, cells attached to glass surfaces were quantified using crystal violet binding assay previously described by Stepanovic et al. (2004) with some modifications. The broth was withdrawn at the end of each day and the glass vials were washed 3 times with 5 ml of sterile distilled water. The remaining attached bacteria were fixed with 1 ml of 70% ethanol per glass vial. And after 15 min the glass vials were emptied and air dried. The glass vials were then stained with crystal violet for 5 min. Excess stain was rinsed off by placing the vials under a running tap water. After the glass plates were air dried, the dye bound to the adherent cells was re-solubilized with 1 ml of acetic-nitric acid per glass vial. The re-solubilized liquid was then poured into a cuvette. The optical absorbance (OD) of each liquid against a blank reading without inoculation was measured at 620 nm for *L. monocytogenes* using a spectrophotometer. Based on the OD produced by isolates strains were classified as no biofilm producers, moderate or strong biofilm producers as previously described by (Stepanovic et al., 2000). $< 0.114 = /<$ blank reading meant no biofilm formation, $0.160 - 0.260 = 2x$ blank reading meant moderate biofilm producer while $> 0.300 = /<4x$ blank reading meant strong biofilm producer (Stepanovic et al., 2000, 2004).

Quantification of cellulose produced by the isolates

On each of the sampling days for each isolate 10 mls of the broth culture was pipetted and dispensed into 15 ml centrifuge tube. The culture was then centrifuged at 3000 rpm with a centrifuge. The supernatant was decanted after centrifuge. Three millilitres of acetic nitric acid reagent was then added in two installments (1 ml then 2 mls) and mixed on the vortex on each addition. Tubes were covered with foil to reduce evaporation and create reflux and then placed in boiling water bath for 30 min. After this period of boiling the tubes were centrifuged again for 5 min at 3000 rpm. The supernatant was decanted and 10 mls of H₂SO₄ was added in 3 installments with intermittent mixing. The mixture is allowed to stand for 1 h. One milliliter of mixture is then dispensed in test tube containing 100mls of distilled water. This was vortexed and 1 ml of the mixture was dispensed into 4 ml of distilled water. The mixture was then placed in ice bath to cool. Ten millilitres anthrone reagent was added by layering with a pipette. This was followed subsequently by thorough mixing and placing tube back in ice bath until all tubes were mixed. The tubes were then capped and placed in boiling water for 16 min, cooled on ice bath for 2 - 3 min and allowed to stand at room temperature (26-28°C) for 5 - 10 min. One millilitre of each sample was placed in each cuvette for subsequent reading in the spectrophotometer. The absorbance of each sample was then read on the spectrophotometer at 620 nm wavelength against a reagent blank (Updegraff, 1969).

Statistical analysis

The experiments were done in replicates and duplicate readings were taken for each isolate. Data was reported as means. To identify the relationship between biofilm formation and cellulose production, microsoft excel 2008 was use to assess the level of correlation (R²) between the virulent characteristics. Pearson's correlation was used to determine the significant differences among the strains based on a 95% confidence limit.

Results

Listeria counts were in the range of $2.72 \times 10^6 - 3.36 \times 10^8$ cfu/gm for 'wara' cheese and $5.02 \times 10^7 - 2.0 \times 10^9$ cfu/gm for yoghurt processing (data not shown). *Listeria monocytogenes* was isolated at all the processing stages for 'wara' cheese and yoghurt.

Quantification of cellulose and biofilm formation by *Listeria monocytogenes*(LM) strains at 24 and 48hrs incubation demonstrate that most *Listeria monocytogenes* strains produced moderate amounts of biofilm. All the strains produced biofilm and exopolysaccharide at 24hr and 48hr incubation. Biofilm and exopolysaccharide production increased with incubation time in 14 out of the 31 strains. R² values obtained were 0.002 and 0.125 respectively for biofilm and cellulose production at 24 and 48 hr incubation (P - values of < 0.05). (Figures 1 and 2) A weak positive correlation ensued between biofilm and cellulose production at 48hr incubation (R² = 0.125) (Figure 3). No particular trend was observed for biofilm and cellulose

production among *Listeria monocytogenes* strains from the two sources (yoghurt and cheese).

Discussion

All *Listeria* counts exceeded international limits (The USA require absence of *L. monocytogenes* in 25 g of foods (“zero tolerance”) and biofilm forming *Listeria monocytogenes* was isolated at all the processing stages of the two products in this study. This is of public health significance since consumers of ‘wara’ and yoghurt are at risk of contacting Listeriosis.

A positive correlation was observed between the cellulose production and biofilm formation by *Listeria monocytogenes* strains at 24hrs and 48hrs. This agrees with reports by Adetunji, and Adegoke (2008) who also reported a positive correlation between cellulose production and biofilm formation by *Listeria monocytogenes*. Other studies (Hood and Zottola, 1997; Gulsun et al., (2005) also suggests that higher producers of these factors have higher virulence than lower producers.

The *L. monocytogenes* strains produced biofilms, which varied significantly at ($P < 0.05$). Similar variations in biofilm formation at 24 and 48hrs were reported by Adetunji and Adegoke, 2008. They reported differences in the ability of strains to attach to a glass surface which was the first report on biofilm ability of *Listeria. monocytogenes* strains from the Nigerian local cheese ‘wara’. A similar report suggesting differences in biofilm forming ability was made by Norwood and Gilmour, (1999).

An increase in biofilm formation and cellulose production with extension of incubation time was observed in some ($\approx 50\%$) of the strains. Stepanovic et al., (2004) reported an increase in biofilm formation with extension of incubation time similar to this study. In an earlier study the quantitative recovery of purified cellulose for culture also reflected an increase and some variations with extension in incubation period (Borucki et al., 2003; Adetunji and Adegoke, 2007), although this study compared cellulose with the bacteria cell count.

No particular trend was observed for biofilm and cellulose production among *Listeria Monocytogenes* strains from the two sources (yoghurt and cheese). Other researchers have obtained the same results. Chae and Schraft (2000) reported that the *Listeria monocytogenes* strains they investigated varied significantly in their ability to adhere and produce biofilm, but no trends could be observed when serotypes and source of the isolates were compared. Kalmokoff et al.,(2001) also could not find a direct correlation between the serotype or source and the levels of absorbed *Listeia. monocytogenes* cells.

In conclusion, our results indicate that the biofilm formation and cellulose production by *Listeria monocytogenes* strains are not affected by their sources. Cellulose production by *Listeria monocytogenes* enhances its ability to form biofilm on glass vial, thereby potentially resulting in increased difficulty in removing or killing cells by routine cleaning and sanitizing procedures used in food-processing environments. Although Leriche and Carpentier (1995) and Kim and Frank (1995) reported that the attachment of a given pathogen to surfaces may be aided by the formation of a mixed-cultured biofilm which are different processes.....

A positive correlation observed between biofilm formation and cellulose production suggest that further studies is needed on roles and factors that are involved in biofilm formation and cellulose production in establishing *Listeria monocytogenes* on surfaces in order to put forth more effective control measures.

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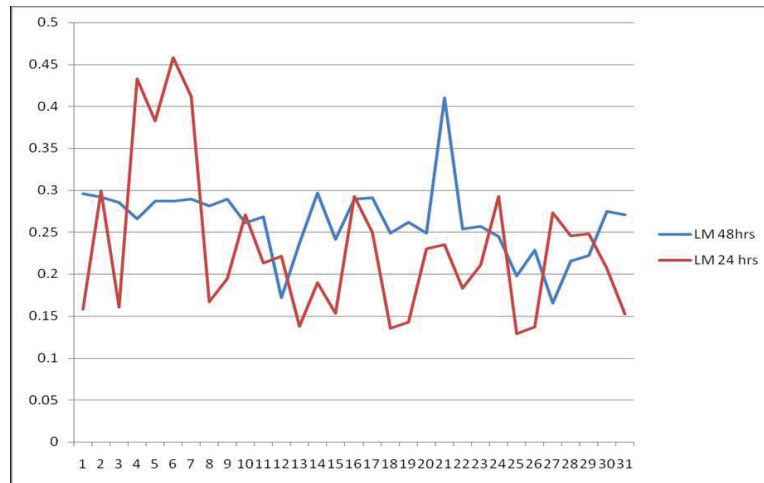


Figure1. Biofilm formation of *Listeria monocytogenes* strains from Yoghurt and Wara processing environments at 24 and 48hrs incubation ($R^2=0.002$)

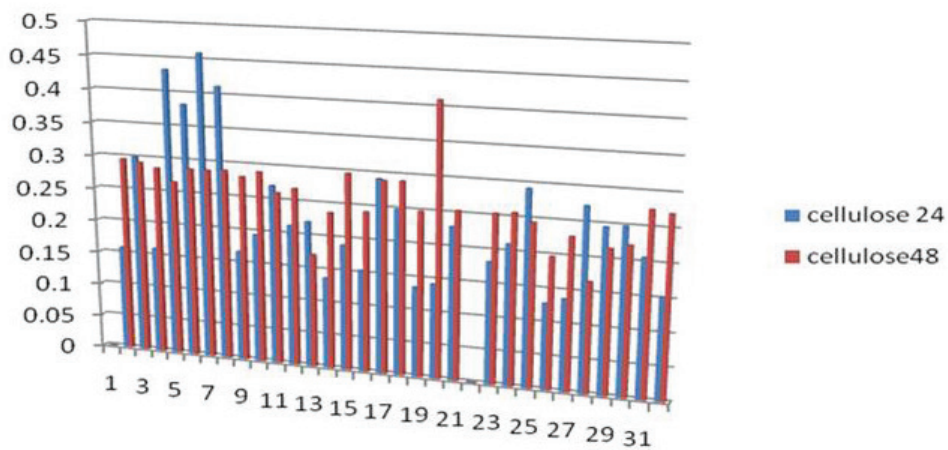


Figure 2. Cellulose production by *Listeria monocytogenes* strains from Yoghurt and Wara processing at 24 and 48hrs incubation ($R^2=0.125$)



Figure 3. Correlation between biofilm and cellulose production at 48 hours incubation period for *L. Monocytogenes*

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Effects of Processing on Lead and Cadmium Contents in Yoghurt and 'wara' Cheese Processing

Adetunji V.O

*Department of Veterinary Public Health and Preventive
Medicine University of Ibadan, Ibadan
Nigeria*

Heavy metals are widely dispersed in the environment and toxicity effects induced by levels of these metals when occurring in food above maximum residue limit are well known. Presence of these heavy metal in dairy products is due to several factors, more importantly contamination during processing and environmental conditions. Variations in lead and cadmium contents were determined by atomic absorption spectrophotometry in samples taken along the processing lines of cheese and yoghurt. Five cheese and two yoghurt processors were assessed in this study. Cadmium was detected at a lower level than lead in the 2 dairy products assayed in this study. The mean levels of lead and cadmium in cheese and yoghurt were $(0.0298 \pm 0.0104, 0.0062 \pm 0.0034)$ and $(0.0174 \pm 0.0101, 0.0022 \pm 0.0009)$ in ppm respectively. Some of these values were significantly higher than values recommended by WHO/FAO. Initial levels of these metals in raw milk used for processing probably sources of metals in the end products (yoghurt and cheese). It was also observed that the processing stages had significant effect ($p < 0.05$) on the level of heavy metals present in the finished products. A significant difference ($p < 0.05$) was obtained between the lead and cadmium levels at the various stages of processing of cheese especially at the point of addition of coagulants (Ac) and curdling point (Cp) stage. The coagulant used at the Ac stage and chemical-physical changes from equipment used for processing were suggested for the differences observed. For the yoghurt processors, processing lines for both processors differ significantly; hence, each processing stage had a significant effect on heavy metal levels in individual samples. However, the inoculation stage (In) and Fermentation stage (Ft) significantly ($p < 0.05$) affected lead and cadmium levels in the finished products from both processors. Critical control points identified include: addition of coagulants (Ac) and curdling point (Cp) stage for cheese; inoculation stage (In) and Fermentation stage (Ft) for yoghurt. This study revealed that some of the dairy products investigated are not safe for human consumption. Generally these findings of contamination during the manufacturing process of cheese and yoghurt will be useful in food safety applications.

Keywords: Lead, Cadmium, Cheese, Yoghurt, Critical Control Points, Processing

Introduction

Milk and milk products are essential components of the human diet, cheese and yoghurt being basic dairy products is rich in protein, fat, calcium, riboflavin and other vitamins. Hence, milk is a main constituent of daily diet, especially for vulnerable groups such as infants, school age children and old age (Davies *et al.*, 1986). These products are prone to contamination during handling and manufacturing/processing thus, presenting a potential risk after ingestion of contaminated milk and milk products.

The amount of metals in uncontaminated milk is admittedly minute, but their contents may be significantly altered through manufacturing and packaging process as well as metals that contaminate different cattle feed and environment such as lead, cadmium, chromium, nickel and cobalt could be excreted into milk at various levels (Abou-Arab *et al.*, 1994, 1997).

Heavy metal residues of dairy products constitute contaminants to milk because they are not intentionally added to the food nor were they constituents of the food substances. Contamination by these trace elements occur; during food handling, processing, through the feedstuff of animals for human consumption (Nasreddine *et al.*, 2002), treatment, packaging and transportation or as a result of environmental pollution.

These toxic elements; lead and cadmium are natural constituents of the earth's crust, they are taken up from the soil by plants and transferred further in food chain. Of all the toxic metals released in large quantities into the environment, cadmium (Cd) is generally regarded as the one most likely to accumulate in the human food chain (Tahvonen, 1996). The source of the lead (Pb) is unclear although many routes of exposure have been suggested. Pollution of the environment with metals such as lead is a world-wide problem; lead alkyl additives in petrol are combusted, emitted into atmosphere and can

be responsible for high concentration of lead in some vegetation, road-side soil, air, water and plants (Burguera *et al.*, 1988). Manufacturing processes, incineration of refuse and combustion of coal, are also the other sources that contribute to lead in the atmosphere, hence it is not surprising that analyses of; local water supplies (Kapu *et al.*, 1989) and dairy products sold locally have been reported to contain significant amounts of lead (Fakayode and Olu-Owolabi, 2003; Maduabuchi *et al.*, 2006).

On the other hand, cadmium is also easily volatilized at the operating temperatures of common industrial processes, much of the cadmium in the atmosphere results from incineration of ferrous scrap and metallurgical processes (Thomas *et al.*, 1972). Cadmium is considered to be one of the most toxic metals; ranked fifth among other toxic metals (Nies and Silver, 1989), it has been implicated in high blood pressure (Perry *et al.*, 1979), prostate cancer, mutations and foetal (embryonic) death (Pitot *et al.*, 1996).

Spivey Fox (1987) proved that milk is a significant source of Cd and contributes to about 54.5% of the FAO/WHO provisional tolerable intake for children. More recently, Muller *et al.* (1996) and Ryzewska and Krol (1996) reported that milk and milk products are still contributing to Cd intake in humans.

The heavy metal content of various types of cheese have been investigated into (International Dairy Federation, 1992; Moreno-Rojas *et al.*, 1994; Zurera-Cosano *et al.*, 1994; Tahvoren and Kumpulainen, 1995) and observed to vary with factors such as; differences between species, geographical location, characteristics of the manufacturing practices and possible contaminant from the equipment during processing (Moreno-Rojas *et al.*, 1994).

Several studies have dealt with heavy metal concentrations in milk, dairy products and tissues (Sivertsen *et al.*, 1995; Peyrovan and Amirabadi, 1996; Lopez-Alonso *et al.*, 2000; de Souza-Lima *et al.*, 2002; Sedki *et al.*, 2003; Licata *et al.*, 2004; Merdivan *et al.*, 2004), while, some studies reported that, the manufacturing processes may influence heavy metal concentrations in dairy products (Coni *et al.*, 1996; Nardone and Valfre, 1999).

To our knowledge, information on the heavy metal residues in the Nigerian soft un-ripened cheese 'wara' is scarce, especially the effects of processing on the heavy metals residues in this product. Few research has been done on yoghurt, despite the fact that it is widely consumed by a large percentage of the populace either in the local form or the industrially made.

The intake of heavy metals as a result of consumption of contaminated milk and milk products has toxic effects depending on the contamination and absorption levels. Toxicity, also results from chronic exposure to low concentration of heavy metals or a short-term exposure to higher concentration. Symptoms of heavy metal toxicity include dizziness, nausea, vomiting, diarrhea, sleeping disorders, loss of appetite and reduced conception rate. Heavy metals have also been linked to cardiovascular disease, depressed growth, impaired fertility, nervous and immune system, disorders increased spontaneous abortions and elevated death rate among infants (Carl, 1991).

Due to the potential health risk the levels of heavy metals in milk and milk products (cheese and yoghurt) presents, this study evaluated the effect of processing on heavy metal residues and identified Critical Control Points (CCPs) for heavy metals in these dairy products.

Materials and Methods

Sampling sites

Cheese samples were collected from five different cheese processors at a Fulani settlement; Gaa Bolorunduro village at the University of Ilorin campus, Ilorin, Kwara state, Nigeria. Yoghurt samples were collected from two conventional yoghurt processors at Offa and Oko-Erin garage both in Ilorin Kwara state, Nigeria. The raw milk used for processing was obtained from the white Fulani and Gudali local breeds of cattle.

Sampling protocols

Samples were collected aseptically at each stage of processing of cheese and yoghurt, using rigorous procedures in order to minimize possible external contamination. Samples were taken at each step of processing for 'wara' cheese (raw

milk (Rm), addition of coagulant (Ac), curdling point (Cp) and cheese in mould (Cm) and for yoghurt (powdered milk (Pm), pasteurization (Pt), inoculation of starter culture (In), fermentation (Ft) and finished product (Fp). At each sampling, 10 ml/10gm of sample was drawn. Each sample was collected in replicates.

Cadmium and Lead determination

The analysis of Pb and Cd was done using Atomic-Absorption- Spectrophotometry (AAS). The samples were freeze dried for 24hours after which it was crushed in a mortar and pestle to homogenize it, variable weight of each sample was then taken between 0.1-0.5g into 75.0ml glass digestion tubes. The combined stock standard was prepared from the reference standards and stored in the refrigerator until use. The method of calibration curve was used for calibration and quantification of the AAS to its effective position. The certified sensitivity check sample for each element was used to optimize the efficiency of the AAS getting 0.200 absorbance for each sensitivity check for standard solutions aspirated during the measurement for each element. The working standards were first determined to create the standard curve, this was followed by the measurement of the unknown analytes. The AAS was adjusted to specific wavelength corresponding to each of the metals to be measured. Measurements were done using the hollow cathode lamps at the wavelength of 283.3 and 228.8 for Pb and Cd respectively. A probe of the equipment was inserted into the liquid samples and read on the meter.

Data analysis

Analysis of variance (ANOVA) was used in identifying significant differences along processing lines and among the processors. SPSS 15 (2003) univariate and a multivariate tool were used to investigate the correlation structure of the data (Legendre and Legendre, 1985).

Results

The results of the heavy metals levels in samples taken along the processing line of cheese from the various processors are recorded in Tables 1 and 2; Figures 1 and 2. The lead and cadmium levels in raw milk used for processing ranged from 0.0521 ± 0.0001 - 0.0172 ± 0.0004 and 0.0147 ± 0.0001 - 0.0028 ± 0.0001 respectively, the highest values recorded in processor A. Lead levels in samples taken at the addition of coagulant stage (Ac) were significantly different from that in raw milk except in processors B and D. The curdling point stage (Cp) was not significantly different from the cheese in mould (Cm) for all cheese processors except processors A and D, however, at the various stages of processing, levels in each processor was significantly different from one another except at Ac stage where processors B and D were not significantly different. Moreover, there were significant differences in lead contents of samples from different cheese processors.

For cadmium levels, processors A had a significant difference in all the stages of processing, processors B and C had no significance difference in cadmium levels along their processing lines while levels in finished products of processors D and E were not different from levels in raw milk.

Considering the yoghurt processors (F and G), results of heavy metal residues in samples analyzed and levels of significance are in Table 3 and Figure 3. Lead levels in samples taken along the processing lines of both processors differs significantly, hence, each processing stage had a significant effect on levels in individual samples. However, levels in both processor was significantly different ($P < 0.05$) during the Powdered milk (Pm) stage and the finished product (Fp). Lead levels were observed to reduce during the inoculation (In) stage and later increased during the fermentation (Ft) stage of processing.

Cadmium levels among the yoghurt processors showed significance at ($P < 0.05$) level during the Pm, In, and Fp stages. Levels in the finished products was not different from that in In and Ft stages in Processors F and G respectively, hence these stages (In and Ft) influenced the cadmium levels in the processors.

Discussion

The health effect of heavy metal contaminants in dairy products are a major health concern today. These dairy products are among the Ready- To- Eat Foods (RTE), majorly consumed by different categories of people of all ages. Cadmium absorption depends on the composition of the diet and the nutritional status of an individual's iron status (Flanagan et al., 1998; Wright et al., 2003). Therefore, the poor nutritional status of many Nigerians will likely exacerbate lead and cadmium

Table 1: Lead levels (ppm) in samples taken along the processing lines of cheese from various processors (A-E)

Processors Stages	A	B	C	D	E
Rm	0.0521±0.0001 ^{aA}	0.0209±0.0003 ^{aB}	0.0303±0.0002 ^{aC}	0.0245±0.0002 ^{aD}	0.0172±0.0004 ^{aE}
Ac	0.0518±0.0001 ^{aA}	0.0240±0.0002 ^{bB}	0.0308±0.0003 ^{aC}	0.0237±0.0002 ^{bB}	0.0171±0.0003 ^{aD}
Cp	0.0329±0.0001 ^{bA}	0.0280±0.0000 ^{cB}	0.0420±0.0004 ^{bC}	0.0302±0.0004 ^{cD}	0.0157±0.0002 ^{bE}
Cm	0.0325±0.0001 ^{cA}	0.0283±0.0002 ^{cB}	0.0421±0.0002 ^{bC}	0.0225±0.0001 ^{dD}	0.0151±0.0002 ^{bE}

Values represent: Means ± Standard Deviation (ppm); MRL (0.001-005PPM in milk); (0.055ppm in cheese)

Processing stages: Raw milk (Rm), Addition of coagulant (Ac), Curdling point (Cp), Cheese in mould (Cm).

Values not containing a common uppercase letter in the same row are significantly different ($P < 0.05$) with respect to the processing stage across the processor.

Values not containing a common lowercase letter in the same column are significantly different ($P < 0.05$) with respect to the processor along the processing stages.

Table 2: Cadmium levels (ppm) in samples taken along the processing lines of cheese from various processors (A-E)

Processors Stages	A	B	C	D	E
Rm	0.0147±0.0001 ^{aA}	0.0055±0.0002 ^{aB}	0.0052±0.0001 ^{aB}	0.0039±0.0000 ^{aC}	0.0028±0.0001 ^{aD}
Ac	0.0140±0.0001 ^{bA}	0.0060±0.0002 ^{aB}	0.0056±0.0001 ^{aC}	0.0042±0.0001 ^{bD}	0.0032±0.0001 ^{bE}
Cp	0.0124±0.0001 ^{cA}	0.0055±0.0010 ^{aB}	0.0059±0.0001 ^{aB}	0.0036±0.0001 ^{cC}	0.0029±0.0001 ^{abC}
Cm	0.0118±0.0001 ^{dA}	0.0046±0.0001 ^{aB}	0.0064±0.0002 ^{aC}	0.0038±0.0000 ^{aD}	0.0027±0.0002 ^{aE}

Values represents: means ± standard deviation in ppm; Cd levels within MRL(0.02PPPM)

Processing stages: Raw milk (Rm), Addition of coagulant (Ac), Curdling point (Cp), cheese in mould (Cm).

Values not containing a common uppercase letter in the same row are significantly ($P < 0.05$) different with respect to the processing stage across the processor.

Values not containing a common lowercase letter in the same column are significantly different ($P < 0.05$) with respect to the processor along the processing line.

Table 3: Heavy metal levels in samples taken along the processing lines of yoghurt from various processors (F and G)

Processors Stages	Lead		Cadmium	
	F	G	F	G
Pm	0.0230±0.0001 ^a	0.0308±0.0002 ^a	0.0024±0.0001 ^a	0.0031±0.0002 ^a
Pt	0.0000±0.000 ^b	0.0160±0.0003 ^b	0.0000±0.0000 ^b	0.0028±0.0001 ^{ab}
In	0.150±0.0004 ^c	0.0097±0.0003 ^c	0.0020±0.0001 ^c	0.0024±0.0004 ^{ab}
Ft	0.0191±0.0002 ^d	0.0117±0.0002 ^d	0.0032±0.0001 ^d	0.0020±0.0006 ^b
Fp	0.0129±0.0003 ^c	0.0105±0.0001 ^c	0.0018±0.0001 ^c	0.0020±0.0004 ^b

Values represents: means ± standard deviation in ppm, *=Pm exceeding international limit(0.001 0.005ppm)

Processing stages: Powdered milk (Pm), Pasteurization (Pt), Inoculation of starter culture (In), Fermentation (Ft), Finished product (Fp).

Values not containing a common lowercase letter in the same column are significantly different with respect to the processor along the processing line.

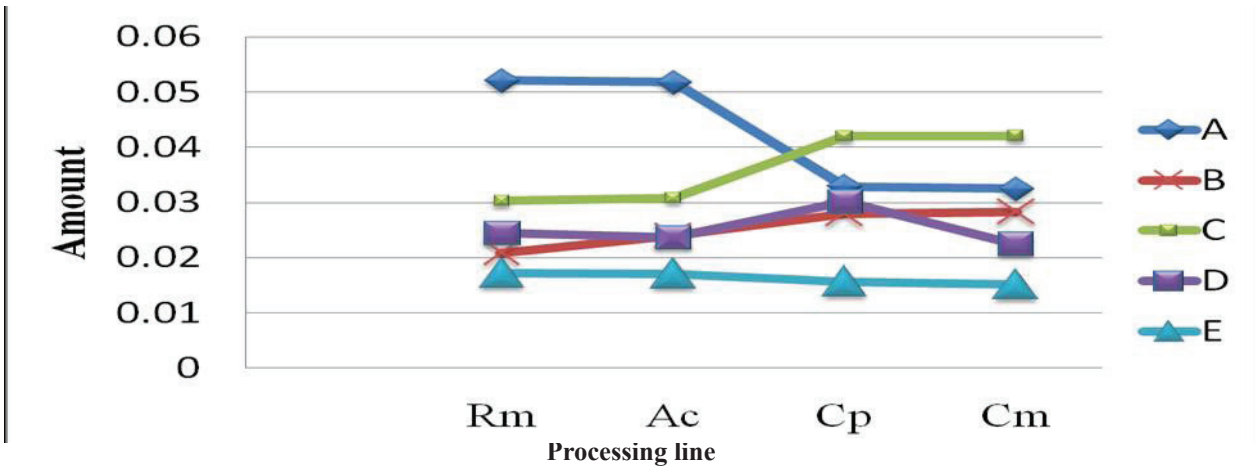


Figure 1: Lead levels (ppm) in samples taken along the processing line of cheese from various processors(A-E)

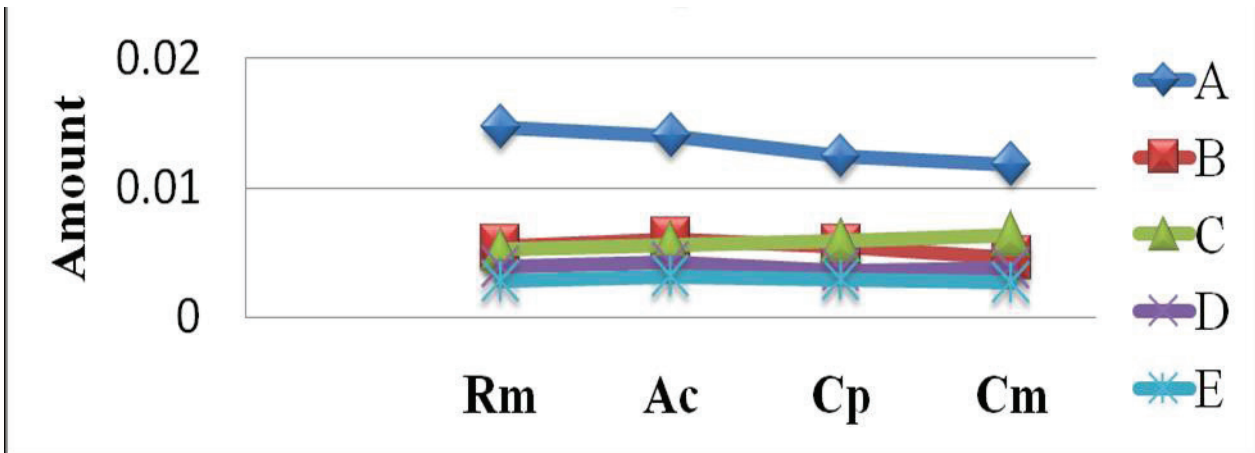


Figure 2: Cadmium levels (ppm) in samples taken along the processing line of cheese from various processors (A-E)

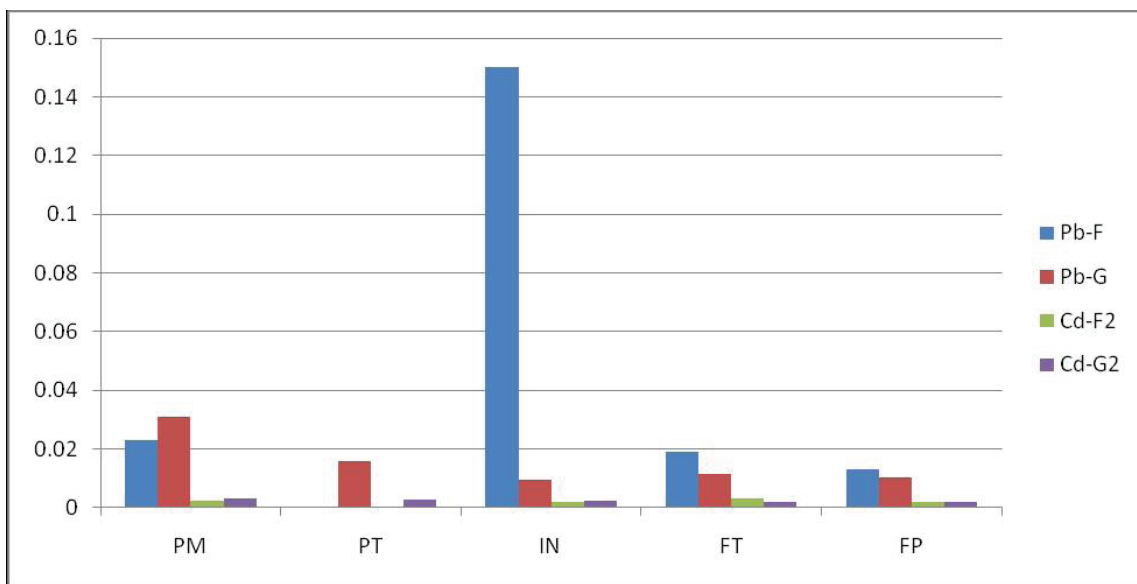


Figure 3: Heavy metal levels (ppm) in samples taken along the processing lines of yoghurt processing; Key: F ; G = processors; Pb = lead ; Cd = cadmium

loading in populace that consumes these products. Although blood lead level BLL<10 mg/dl is currently considered as the threshold for concern in the United States (CDC, 2007), several studies suggest that there is no safe dose for lead exposure, especially among children (Rogan and Ware, 2003). In addition there is still much uncertainty regarding the magnitude of these effects (Needleman and Landrigan, 2004).

The lead and cadmium levels observed in the raw milk use for processing is in agreement with that reported by several works, where varying levels of lead and cadmium were detected in raw cow milk (Dabeka et al., 1987; Tripathi et al., 1999; Onianwa et al., 1999; Lante et al., 2004; Caggiano et al., 2005). The cadmium levels were lower compared to those observed in milk sampled in Finland (<0.1µg/kg) (Tahvonen and Kumpulainen, 1995). This further confirms the fact that, it is possible to obtain residue levels of heavy metals in milk that will be used for cheese processing (Rubio et al., 1998) thus, identifying one of the sources of heavy metals in dairy products.

For the lead levels, the significant difference observed between the Cp and Cm stages in processors A and D as compared to other processors could be as a result of the type of pots used. The use of alloy of metal pots can account for the differences observed. This is in agreement with chemical-physical mechanisms linked to the curdling stage in the cheese production process (Coni et al., 1996).

Difference at the Ac stage from others by processors B and D can be explained by the difference in the coagulant used, this concise with results obtained by Adetunji and Salawu, 2008 where significant differences were observed in heavy metal levels in cheese processed with *Calotropis procera* and *Carica papaya* leaves. These findings accounts for the differences observed in samples obtained from various cheese processors and shows that, some contamination occurred during milk production and /or manufacturing of cheese depending on the equipment used. Therefore further research is needed to determine the exact source of contamination.

Levels of cadmium in samples from processor A were affected by the processing stages as they were significantly different along the processing lines, this agrees with the suggestion made by Marletta and Favretto (1983) and Milhaud et al., (1998) that part of the cadmium levels found in curds and cheese can result from contamination in the manufacturing process.

The difference in coagulant used can further explains the difference observed in processors B and C, while recontamination from equipment used for processing can account for the similar levels observed in samples taken at the Cm stage and from raw milk (Rm) in processors D and E. Thus, it is important to consider the characteristics of the manufacturing process, the degree of ripening, contamination during processing and ripening (Rojas et al., 1994), as reasons for the variations in samples observed among the cheese processors.

Among the yoghurt processors (F and G), lead levels at the Pm stage determines levels in the finished product (Fp), also material used for packaging of the finished product could have exacerbate levels of lead in the finished product. The reason for the reduction in levels at the inoculation stage (In) stage is not clear, but may be due to some contamination of the inoculums. However the increase observed during the fermentation (ft) stage can be due to the bowls used for fermentation and the holding temperature which could allow for chemical reactions between the metals and the contents in the bowls. While for the cadmium levels, the type of starter culture added (In- stage) and the fermentation stage affected the levels in these processors.

Moreover, the significant differences ($P<0.05$) at 95% confidence interval in Pb and Cd content in cheese and yoghurt sampled from the various processors is similar to that obtained by Yuzbasi, 2003, who explained the fact that, mineral content of cheese and yoghurt depends on several factors such as; the differences in mineral content of milk and coagulant used in producing them.

The Pb and Cd contents of samples analyzed explains the fact that heavy metal residues of cheese and yoghurt depends on a number of factors such as; the source of water supply, environmental conditions e.g. emission from exhaust of vehicles and industrial wastes. Some values (raw milk and powdered milk) exceeded international limits of 0.001-0.005ppm for Pb (Cd were within limits of 0.02ppm (UK food and drugs regulation 1999). It should be considered a public health problem since Pb exceeded maximum residue limits (MRL), this also reflects the significance of this study.

Conclusion

In sum, results from this experiment reveals that it is expedient in the interest of public health to educate local processors on the effect of consuming heavy metals in foods and introduce mandatory assay for heavy metal residues in cheese and yoghurt produced in this country. It is feared that continuous ingestion of these products may constitute a significant route of heavy metal exposure, especially to children; hence it should be considered a public health problem.

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Comparative Evaluation of Productivity and Cost Effectiveness of Catfish Fingerling Production in Earthen Pond and Recirculation System in Ibadan, Nigeria

Adeyemo, O.K, Ganiyu, O.I. and Olugasa, B.O

Fish and Wildlife Unit

*Department of Veterinary Public, Health and Preventive Medicine, University of Ibadan
Nigeria*

Despite the popularity of the African catfish and its great market potentials, the production is still basically at subsistence level due majorly to inadequate availability of seed for stocking. This has been linked to the absence of reliable production techniques for the mass production and rearing of the species under practical farming conditions. The purpose of this study therefore, was to find a suitable culture system for the mass production of catfish (*Clarias gariepinus*) fingerlings. Protected earthen pond and a unit of recirculation system were used. Both male and female parent stocks were two years and reared in the earthen pond. The fertilized eggs from the female were divided into two equal halves and incubated under the same conditions. Forty-nine thousand fry each were stocked into the protected earthen pond and a unit recirculation system respectively. The fry in the two systems were raised for twenty one days and fed the same quantity and quality of feed throughout the period. The survival rate of the fry in the recirculation system was 79% as against 17% in the earthen pond. However, bigger sized ($2.2 \pm 0.23\text{g}$) fingerlings were obtained from the earthen pond relative to those cultured in the recirculation system ($0.9 \pm 0.07\text{g}$). The cost of raising fry in a recirculation system (₦34,000) was twice that needed for earthen pond (₦17,000), but this was more than made up for in the profit from sales, which was ₦311,360 and ₦99,156 respectively. The main reason for going into fish farming is the expected return to be therefore, the choice of income-generating activities, amongst several options available, should be made on the grounds of their expected returns.

Predominant Bacteria Associated With Catfish Specimens and Hatcheries in Lagos, Nigeria

Akintomide T.O, Jagun A.T, Olufemi B.E and Oladele O.O

*Department of Veterinary Pathology
University of Ibadan
Nigeria*

The study is aimed at identifying the viable and culturable dominant bacterial flora associated with egg hatchability and larvae survivability in sampled catfish hatcheries from four farms, with previous history of bacteria disease outbreaks in Lagos state. Five samples consisting of 0.5 – 1.0ml of fresh milt, stripped ova, vaginal swabs, unhatched ova and few apparently healthy 1 to 2 day-old yolk-sac larvae were collected per farm. Parts of the solid samples (eggs and larvae) were disinfected in 5% dimethyl alkyl benzalkonium chloride solution for 30 minutes, while the other parts were rinsed in sterile water. Some of the samples were crushed prior to bacterial cultured on blood and MacConkey agars, and the isolated (81.8% of the isolates were Gram negative bacteria and 18.2% Gram-positive) bacteria were identified using standard phenotypic taxonomic tools. Occurrence rates of the dominant bacteria were in the order *Citrobacter* > *Aeromonas* > *Corynebacterium* sp. > *Enterobacter* > *Klebsiella oxytoca* > *Vibrio* species > *Pseudomonas aeruginosa*, *Providencia rettgeri*, *Francisella* sp., *Oligella* sp., *Luteococcus* sp., *Citrobacter* sp. and *Corynebacterium* sp. were the dominant flora of fish vagina and milt; while *Aeromonas hydrophila* dominated the fish follicular fluid. *Enterobacter* species predominated the unhatched eggs and day-old larvae but not fresh eggs / milt. *Klebsiella oxytoca* was isolated as a dominant bacterium from vagina, follicular fluid and day-old larvae, thus most likely to be vertically transmitted. *Aeromonas hydrophila* and *Corynebacterium* species, being the most predominant bacteria isolates, also seem to be vertically transmitted in this work.

Key Words: dominant bacteria, catfish, hatchery, Nigeria.

The Reproductive Potential of Male Catfish Treated With Gel Extract of Aloe Vera Plant

Oyeyemi M.O¹, Adeyemo A.K², Owoyemi A.O¹ and Aina A.O³

*Department of Veterinary Surgery and Reproduction
Faculty of Veterinary Medicine, University of Ibadan
Nigeria*

The reproductive potential of male catfish treated with gel extract of Aloe vera plant was studied using twelve male fish of weight ranges between 500 to 560g.

The fish were divided into 3 groups; A, B and C of four fish each. Group A was treated 2% of Aloe vera gel while group B was treated with 3% and Group C the control was treated with distil water. Blood and semen samples were collected for analysis and histopathology of the testis was done.

Spermogram revealed that as the concentration of the gel increase the motility decreased and the different is significant ($p<0.05$). It was also observed that group C (278×10^6 sperm cells/ml), A (249×10^6 sperm/ml) and B (204×10^6 sperm/ml) this indicated that sperm count decreased with increase in Aloe gel concentration, the decrease was not significant ($p>0.05$). The results of the morphological studies showed that group C ($6.50 \pm 0.51\%$), A ($7.27 \pm 0.24\%$) and B ($11.03 \pm 0.42\%$) this indicates significant different ($p<0.05$) between the values of A and B.

It is concluded that concentration higher than 2% of Aloe vera gel in water is detrimental to the reproductive potential of the catfish. It is also noted that both the sperm count and morphological studies indicated that Aloe vera gel will cause negative potential and infertility in the catfish.

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1. *Department of Veterinary Surgery and Reproduction, Faculty of Veterinary Medicine, University of Ibadan*
 2. *Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Ibadan*
 3. *Department of Veterinary Anatomy, Faculty of Veterinary Medicine, University of Ibadan*

Session 8: Workshop on Working Animals

FAO/ Brooke e-Consultation on Working Animals - Summary and Results

Joy Pritchard¹, Dorcas Pratt¹, Daniela Battaglia² and Illia Rosenthal²
The Brooke, 30 Farringdon Street, London, EC4A 4HH, England
United Kingdom

Summary

The Electronic Consultation on the role, impact and welfare of working (transport and traction) animals was held during February 2011 and aimed to consult a wide range of actors to gather evidence on the role and impact of working animals in livelihoods, identify necessary actions to raise their profile and improve their welfare. One hundred and fifty-six people from 52 countries registered for the e-consultation. More than 40 participants contributed to the online discussion and 79 documents on working animals were shared and posted on the FAO Gateway to Farm Animal Welfare.

Introduction

The main objectives of this e-consultation were to gather evidence on the role and impact of working animals in livelihoods (food security, poverty alleviation, income generation, access to services, gender equity and others) and identify necessary actions to improve their welfare and to raise their profile in agricultural and rural development programmes. The e-consultation provided an opportunity for scientists, development workers, governmental institutions and non-governmental organizations, and the international community at large with an interest in working animals and their welfare, to share their knowledge and experiences.

The e-consultation addressed the following themes over 4 weeks during February 2011:

1. The current state of knowledge on the contribution of working animals to livelihoods (food security, poverty alleviation, income generation, access to services, gender equity and other aspects) worldwide.
2. Existing standards and guidelines, case studies and best practices addressing working animal health and welfare.
3. Policies and legislation and recommended further actions at national and international level.

Theme 1: Livelihoods

Participants were asked to share their knowledge firstly on the contribution of working animals to livelihoods worldwide with a focus on food security, poverty alleviation, income generation, diversification of livelihoods, access to services and gender equity. Secondly, information was requested on how these contributions are evolving as societies and economies undergo changes and what consequences this may be having both on people and on animals. A number of experiences and analyses were shared by participants from Asia, Europe, Africa and the Americas, covering the following topics:

- *Uses of working animals to support income generation*
- *Use of working animals to reduce drudgery and support women's and children's labour*
- *Economic evaluation of the work done by working animals*
- *Lack of recognition of the contribution of working animals to livelihoods by governments and policy-makers*

1 The Brooke, 30 Farringdon Street, London, EC4A 4HH, England, UK

2 FAO, Animal Production and Health Division, Room C-581, Viale delle Terme di Caracalla, Rome 00153, Italy

- *Renewed interest in using working horses in Europe*
- *Working cattle and water buffaloes*

Gaps in existing knowledge about livelihoods which were highlighted during the e-consultation:

1. The need to better inform governments and development partners by developing a tool or tools for estimating the monetary value of draft power and other contributions from working animals, to be used at an individual or family / household level.
2. A lack of methods for calculating the contribution of working animals to national economies in countries where animal population data are scarce or unreliable.
3. Further elaboration of a draft document contributed from South Africa which summarised how different species of working animal should be worked and cared for differently according to their different physiology and needs.
4. More information about working bovine species (cattle/ oxen, buffaloes, yaks) and camelids is needed.

Theme 2: Health and welfare

This theme aimed to identify existing standards and guidelines, case studies and best practices addressing working animals' health and welfare. Topics discussed by participants included:

- *Should organisations or governments spend finite resources where there is a better chance of animal welfare improvement or where the welfare need is greatest?*
- *Addressing working animal issues in a sustainable manner; by taking into account the livelihood considerations of their owners*
- *Targeting end-users in order to improve welfare*
- *Assessment/ measurement of welfare*
- *Education on working animal health, welfare and utilisation*
- *Veterinary treatment*
- *Harness interventions*
- *Using participatory tools and methods with animal owners and users*
- *Human-animal relationships*
- *Animal handling and training*
- *Bibliographies, current studies and upcoming publications*

Gaps in existing knowledge about working animal health and welfare highlighted during the e-consultation included:

1. A large amount of knowledge and information exists on working animals, including studies done by armies and transport companies in the past and universities and NGOs more recently. There is a need to collect and render these documents readily available to interested people in user-friendly access areas.
2. E-learning modules could make information more readily accessible within veterinary and other training institutes.

Theme 3: Policy and legislation

Participants were asked to propose adequate policies and legislation and to recommend any further actions at national and international level. The following topics were discussed:

- *Standards – definitions and needs*
- *Trends in working animal populations and usage which could influence policy-making*
- *Oil consumption and energy equivalents*
- *Networking for policy change*
- *Examples of current successes in influencing policy*
- *Anti-cruelty legislation*

Gaps in existing knowledge relating to policy and legislation highlighted by e-consultation participants included:

1. There is a need to develop a commonly agreed “glossary” or set of definitions for the word ‘standards’ and to find a balance between standards being context-specific and being enforceable in practice.
2. We need a better understanding of reasons why governments, policy-makers, educational institutes and other decision-makers often take little or no account of working animals in their policies and practices. An improved understanding of policy actors and processes, especially in cases where attitudes towards the subject may be indifferent or even negative. Policy research which contributes to the understanding of what policy makers want to hear could be an invaluable first step for those trying to address the gaps. Once this is understood, strategies for evidence collection can be drawn up accordingly.
3. There is an opportunity to promote the use of working animals as a carbon-friendly and sustainable energy source. This requires more evidence to demonstrate oil equivalents, more innovation in rehabilitating and modernising the image of working animals and further development of standards which would enable animal power to be included in subsidised renewable energy schemes and carbon offsetting.

Records of the e-consultation, weekly summaries of contributions, documents (a wide range of materials including papers, publications and data) submitted by participants during the consultation period and a full report of the e-consultation are available as a permanent record on the FAO Gateway to Farm Animal Welfare: www.fao.org/ag/againfo/themes/animal-welfare/blog/en.

Findings from the e-consultation, together with those of the further consultation held at the 5th Pan Commonwealth Veterinary Conference, will be taken forward to inform an FAO/ The Brooke Expert Meeting on working animals, which will take place in Rome during June 2011. The Expert Meeting will reflect on the objectives of the e-consultation and the outcomes of the Conference to identify necessary actions to raise working animals profile in agricultural and rural development programmes and to improve their welfare.

Health and Welfare of Working Animals

Joep Van Mierlo, Veronique Renault, Irura Dan

*Vétérinaires Sans Frontières
Belgium*

The health of working animals is not only freedom from diseases but also the state of complete physical, mental, physiological and emotional fitness. It is manifested by ability to meet the needs of the owners and users while working in an efficient and effective manner. The health is closely linked to welfare indicators that should be respected within the social economic and cultural setting where the working animals are found.

The health is manifested by normal body coat with appropriate behavior for the specific species, age, sex and physiological status. The animal must exhibit appropriate reaction to its own kind, the owners, users and environment while manifesting proper posture and gait while working. To achieve peak health the owners and users must conduct regular preventive health care measures including waste disposal, hoof care, vaccination against diseases recommended by local veterinarian, regular deworming and protection from internal and external parasites. The working equipments such as carts, saddles, ploughs must be designed to achieve optimum performance while avoiding injuries to the animal. Owners must prevent the animal's accessing toxic plants or chemicals in the environment and should provide adequate time for rest after work. Health care is assured by provision of quality feed, clean water and mineral supplements to meet the needs of both maintenance and peak performance for the working animals.

The welfare of working animals according to the European Convention for the Protection of Animals kept for Farming is measured by how far the owners and users provide for the animals five freedoms namely 1) Freedom from hunger and thirst through access to quality fresh water and a diet for full health and vigour, 2) Freedom from discomfort by provision of an appropriate environment with shelter and comfortable rest area, 3) Freedom from pain, injury and disease through preventive health care or rapid treatment, 4) Freedom to express normal behavior by provision of adequate space, time and facilities including company of the animal's own kind and 5) Freedom from fear and distress by providing conditions and treatment which avoid mental sufferings.

The health and welfare of working animals is therefore in the hands of the owners and users.

Session 9: Companion Animals

The Electrographic Effects of Thiopentone Anaesthesia in Nigerian Local Breeds of Dogs

Emmanuella A. Olubanke Sogebi, Oludele Ayobami Makinde

*Department of Veterinary Medicine and Surgery
College of Veterinary Medicine, University of Agriculture
PMB 2240, Abeokuta
Nigeria*

This study aims to determine the effects of Thiopentone anesthesia on the various ECG parameters (with a view to having a better management of patient under its use). Five Nigerian local breed of dogs, brought to condition were prepared for the procedure and connected to the multi-parameter patient monitor. Venous access was secured and 0.9% Normal Saline administered at a maintenance flow rate of 60ml/kg/day. Induction was carried out using Thiopentone Sodium at 15mg/kg intravenously. The readings for the ECG parameters were taken pre, intra, and 24hours post anesthesia. Differences were considered significant at $p < 0.05$. There were significant rises in the amplitude of the P-wave 24hs post recovery, the duration of Q-T interval during induction, the amplitude of the QRS complex 24hs post recovery, and a flattening of the T-wave. No significant changes were observed in the duration of the P-wave, the P-R interval, and the QRS complex before, during and after induction of anesthesia. Results showed that Thiopentone had a marked effect on ventricular repolarisation in Nigerian local breed of dogs and, should be avoided in dogs susceptible to ventricular arrhythmias or a long QT interval.

Key Words: Dogs, Electrocardiographic Effects, Thiopentone Anesthesia

Introduction

Electrocardiography (ECG) has been increasingly used as a complementary examination in veterinary diagnosis. Over the last 20 years it has become the most used examination in both human and veterinary cardiology, not only for the diagnosis of arrhythmia but also for the preoperative evaluation of patients (Miller & Tilley, 1988; Tilley, 1992). The preoperative evaluation of cardiac activity is very important in patients with signs and symptoms of fatigue, coughing and dyspnea, suggesting congestive cardiac insufficiency.

Sodium thiopental (STP), better known as Sodium Pentothal (a trademark of Abbott Laboratories), thiopental, thiopentone sodium, or Trapanal (also a trademark), is a rapid-onset short-acting barbiturate general anesthetic. Sodium thiopental is a depressant and is sometimes used during interrogations – not to cause pain (in fact, it may have just the opposite effect), but to weaken the resolve of the subject and make him or her more compliant to pressure (Sydney, 2007).

Following intravenous injection the drug rapidly reaches the brain and causes unconsciousness within 30–45 seconds. At one minute, the drug attains a peak concentration of about 60% of the total dose in the brain. Thereafter, the drug distributes to the rest of the body and in about 5–10 minutes the concentration is low enough in the brain such that consciousness returns.

In veterinary medicine, thiopental is also used to induce anaesthesia in animals. Since thiopental is redistributed to fat, certain breeds of dogs – primarily the sight hounds – can have prolonged recoveries from thiopental due to their lack of body fat and their lean body mass. Thiopental is always administered intravenously, as it can be fairly irritating; severe tissue necrosis and sloughing can occur if it is injected incorrectly into the tissue around a vein (Brodie, et al. 1952).

As with all lipid-soluble anesthetic drugs, the short duration of action of STP is due almost entirely to its redistribution away from central circulation towards muscle and fat tissue. Once redistributed, the free fraction in the blood is metabolized

in the liver. Sodium thiopental is mainly metabolized to pentobarbital, (Winters, 1955) 5-ethyl-5-(1'-methyl-3'-hydroxybutyl)-2-thiobarbituric acid, and 5-ethyl-5-(1'-methyl-3'-carboxypropyl)-2-thiobarbituric acid (Bory, 1986).

It is the best way to measure and diagnose abnormal rhythms of the heart (Braunwald, 1997), particularly abnormal rhythms caused by damage to the conductive tissue that carries electrical signals, or abnormal rhythms caused by electrolyte imbalances (Chest, 2004).

Materials and Method

Animals

The experimental animals consisted of five Nigerian indigenous breed of dogs (3 intact non-pregnant, non-lactating females and 2 intact males) aged between 10 to 18 months with an average weight of 10 ± 2 Kg. They were acquired from owners raising them as household pets. The dogs were housed singly in kennel College at the Veterinary Teaching Hospital and were fed once daily on a diet of rice, stew and fish. Free choice fresh water was provided in the kennels. The dogs were judged to be healthy based on clinical examinations and complete blood count.

Method

The animals were fasted before the commencement of the experiment. The trials were carried out as much as possible at the same time of the day for each dog at room temperature.

The sites of attachment of the electrodes (the right fore and hind limbs, the left fore and hind limbs and the chest) were clipped, the electrodes were attached and the probes of the monitor were fixed on the attached electrodes. Venous access was secured using 21G butterfly needle, 0.9% normal saline was put up at a maintenance flow rate of 60ml/kg/day (Zafar, 2004). The basic parameters (ECG, HR, RR, PR) were obtained from the Multi-parameters patient (General Meditech Inc^(R)) monitor at the commencement of each procedure which served as baseline values.

The unpremeditated animals were induced with 2.5% Thiopentone Sodium () at 15mg/kg body weight intravenously (Muir *et al.*, 2007). The readings were taken for 5 seconds each way while monitoring. The animals were monitored until recovery taking note of all side effects. Readings were taken again 24 hours post recovery.

Data were expressed as mean and standard error of mean. The mean of the three different stages of data reading were compared with each other using one way ANOVA. Differences were considered significant at $p < 0.05$.

Results and Discussion

Selection of anaesthetic agents depends upon species or breed of the animal, nature of surgical operation, susceptibility of the patient to the action of anaesthetic drug and health status of the animal to be anaesthetized. Thiopental sodium had been the sole anaesthetic agent upon which veterinarians have relied in canine surgery.

Induction with thiopentone caused unconsciousness in less than 15 seconds in all the dogs. Thiopentone caused a noticeable increase in QT and ST intervals, as well as a flattening of the T-wave as described by Dennis *et al.*, 2007. However, there were no significant changes observed in all other variables but there were noticeable increases in the amplitude (i.e. height) of both the P-wave (Fig. 1) and the QRS complex (Fig. 3) observed 24 hours post recovery. These increases in the heights of both the P-wave and QRS complex post recovery were however questionable and were thought to might have resulted from sensitive contacts with either the skin of the animals or the electrodes during restraint of animals while taking records 24 hours post recovery.

This experiment revealed that thiopentone induced an increase in heart rate (Table 2 and Fig. 5). These findings are in accordance with those of Muir and Hubbel, 1991, Likiwet *et al.*, 1991, Kumar *et al.*, 1995 and Portella *et al.*, 1996). The heart rate after recovery from anaesthesia returned to normal.

Induction was rapid and smooth but struggling during induction was observed in one animal showed that animal felt

Table 1: Analyzed result comparing the Mean ±SEM

	Before anesthesia	During anesthesia	24hs post recovery
P-wave (h)	0.11±0.02	0.12±0.02	0.21±0.02 ^a
P-wave (w)	0.03±0.0	0.03±0.0	0.03±0.0
P-R interval	0.06±0.0	0.06±0.01	0.06±0.01
Q-T interval	0.10±0.01	0.11±0.01 ^a	0.11±0.0
QRS complex(h)	0.99±0.13	0.94±0.12	1.45±0.11 ^a
QRS complex(w)	0.02±0.0	0.02±0.0	0.02±0.0
ST interval	0.06±0.0	0.07±0.01 ^a	0.06±0.0
T-wave	0.19±0.11	0.04±0.01 ^a	0.18±0.05

P < 0.05. a = significant values

NB: The paper speed was 50mV/s; calibration 1cm=1mv

h=height(Amplitude), was measured in mV;

w=width (Duration), was measured in seconds.

Table 2: The comparison of the mean ±SEM of the heart rates before anesthesia, during anesthesia and 24hours post recovery.

	Before anesthesia	During anesthesia	24hs post recovery
Mean	108.6	130.8	94.40
±SEM	8.44	10.20	18.33
SD	18.88	22.82	40.99

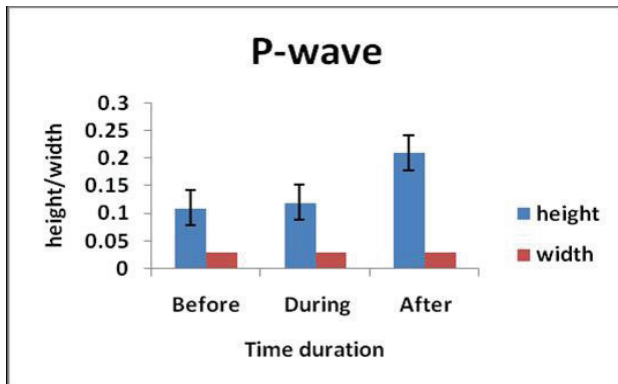


Fig 1: The mean values of height(mV) and width(seconds) of P wave

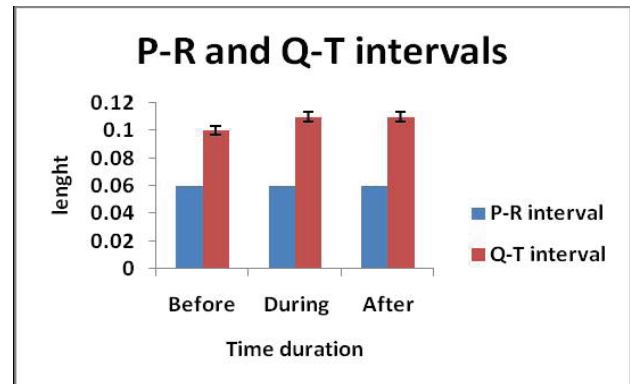


Fig 2 : The mean values of durations of P-R and Q-T intervals in seconds

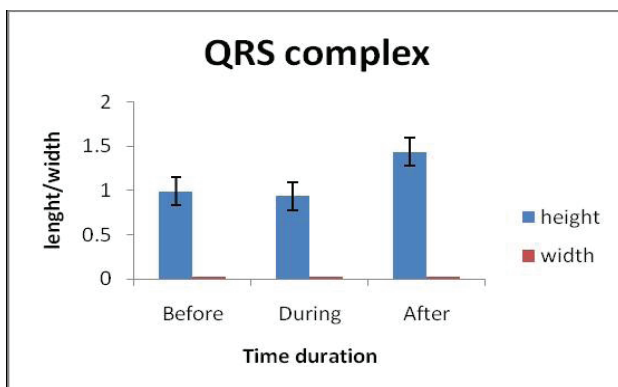


Fig 3: The mean values of height(mV) and width(seconds) of QRS complex

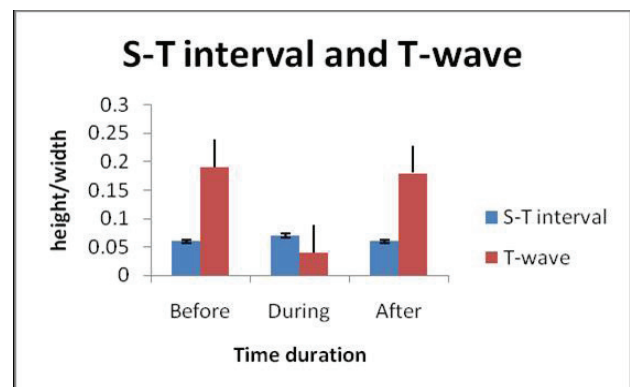


Fig 4: The mean values of width (secs) and height (mV) of S-T interval and T-wave

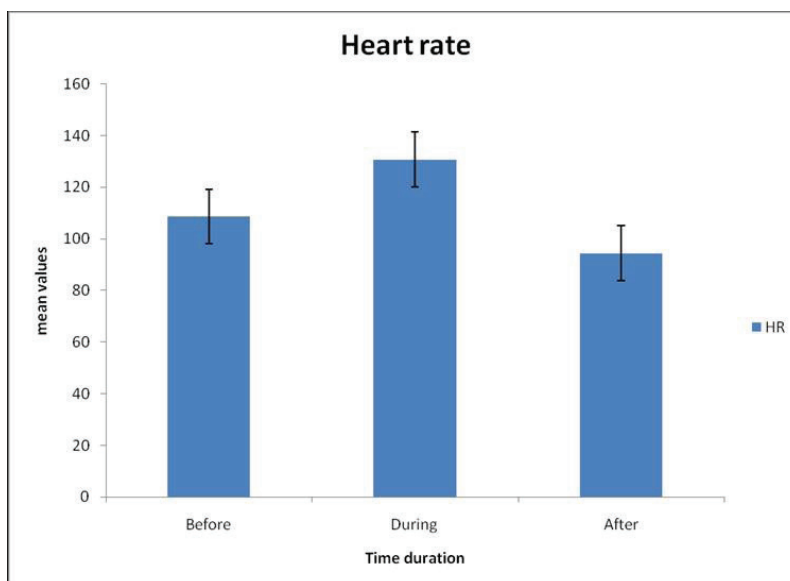


Fig 5: The mean \pm SEM of the heart rates at the different stages

pain. Recovery was accompanied with urination and defecation in all the animals. The recovery from anaesthesia was not smooth in two animals, which do not agree with findings of Kumar *et al.* (1995).

Conclusion

Thiopentone had a marked effect on ventricular repolarisation, changes which suggest that it may be more likely to induce re-entrant ventricular arrhythmogenesis and could be associated with an increase in sympathetic tone.

Recommendations

Thiopentone should therefore be avoided in dogs with a susceptibility to ventricular arrhythmias or a long QT interval.

Further work should therefore be carried out to confirm if Thiopentone actually has effects on the amplitudes (i.e. heights) of P-wave and QRS complex, that is, its effects on atrial depolarization and ventricular myocardial depolarization respectively, especially 24 hours post recovery from anaesthesia.

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Managing a Veterinary Business in Tough Economic Times

Roy Aronson

CiTIVET Tamboerskloof

*42 DeLorentz Street, Tamboerskloof, Cape Town 8001
South Africa*

The world has changed profoundly. Is this not a cliché? Is this not the lament of each and every generation? Probably; but it does not lessen our pain. The world has once again changed; and profoundly.

2008 saw the collapse of economic markets throughout the Western world. Billions if not trillions of dollars were wiped off the face of the planet within a few short weeks. Millions of people worldwide lost their jobs and businesses, banks and possibly even a government or two tumbled down.

Optimists looked at the stock market and when it picked up a point or two they said, “See, a recovery”. Others see the fluctuations in stock markets as a measure of the temperature of the disease. Companies shed workers and revert to their core business. They downsize then start showing a profit and up goes their shares. The stock market grows a few points. The pundits say we are recovering.

There are others who believe the world has entered into a thirty year deflationary cycle. Modify your business practice to survive. I subscribe to this theory. My challenge is to make my veterinary practices work in this period.

There are two aspects to business; income and expenditure. The challenge in the veterinary business is to make more income, keep expenditure down and not compromise on quality of care. This is big challenge.

Over the next few moments I will show you, via record keeping, how I manage to do this. I am sure that my way is one of many different theories. I do not put down any of them. My way is simple and quick, and is easy to set up; it works for me. If you have your own method and it works, stay with it. If you don't have a method, get one NOW. Try mine, it may work for you. If it does not, then find another method but get one quickly before it is too late.

The most important aspect of any method is accurate record keeping. I use an excel spread sheet with a specific format. I extract the information to ensure that my business stays viable and even thrives in these tough economic times.

Predictors of Clients' Satisfaction with Delivery of Animal Health Care Services in Peri-Urban Ghana

Paa Kobina Turkson

Animal Science Department

*School of Agriculture, University of Cape Coast, Cape Coast
Ghana*

Identifying and meeting client needs is critical to total quality management in animal health care delivery systems. Client satisfaction surveys have been used in many disciplines to help identify barriers to quality service delivery. Being able to predict client satisfaction with delivery of services would, therefore, be an asset to the service provider. This paper set out to determine the predictors of satisfaction with delivery of veterinary services in peri-urban Ghana and develop a model(s) that best explained client satisfaction. The study used logistic regression modelling to determine predictors of satisfaction with delivery of animal health care services for 889 clients (livestock and poultry keepers) in peri-urban Ghana. Of the 15 indicators tested as predictors of satisfaction in this study, eight were included in the best fit model. These were accessibility, availability of services, service charge, effectiveness, efficiency, quality of services, meeting client needs and getting help. Efficiency and effectiveness were perceived by the respondents to be synonymous, as were service quality and effectiveness, as suggested by ORs > 10 when cross tabulated. Therefore, one or the other could be used in future studies but not both to avoid collinearity. The identified predictors could be targeted for improvement in quality of service delivery. This paper has, for the first time, provided predictors of client satisfaction with delivery of animal health care which could be used in improving quality of delivery of services to livestock and poultry keepers in Ghana and elsewhere.

Keywords: Animal health; client satisfaction; Ghana; peri-urban; predictors; service delivery; veterinary services

Correlation of The Cytologic and Sonographic Measurement of Uterine Diameter at Various Stages of the Oestrus Cycle of Indigenous Bitches

Lawal M¹, Hassan A.Z¹, Chom, N.D², Remi-Adewunmi, B.D and Ogunkoya, A.B

*Department of Veterinary Surgery and Medicine
Ahmadu Bello University, Zaria
Nigeria*

Ultrasound is often use as a complement to other diagnostic protocols. In many cases this is because ultrasonography provides spatial relationship of organs within the abdomino-pelvic region. This study was designed to examine, visualize and also measure the uterine luminal diameter and correlate the measurements with changes in vaginal cytology occurring during the estrus cycle in the bitch in order to provide baseline information correlating the sonographic and cytologic changes that occurs during the various phases of the reproductive cycle in Nigerian indigenous bitches. To conduct this study, ten (10) mature bitches that had whelped at least once and at most twice were used. Baseline ultrasound data were obtained during the one month acclimatization period. Each bitch was given 1ml vial of Human Chorionic Gonadotropin (HCG) intramuscularly on day 1 and repeated after 48 hours. The sampling was done on days 1, 3 and 5 of the experiment. Ultrasound examination was conducted to visualize the internal genitalia and also measure the uterine luminal diameter throughout the study period. Following the first treatment, some of the bitches started showing characteristic physical signs of estrus. The result of the vaginal cytology showed all of them were at diestrus on day 1 of the experiment, with large rhomboidal cells beginning to lose their nucleus, vaginal nucleated cells and neutrophils. At this time the mean uterine luminal diameter was 5.5mm + 0.70mm. Three bitches (30%) were at early proestrus with neutrophils, parabasal cells and mucus while seven (70%) were at late proestrus with erythrocytes, superficial cells and absence of neutrophils on day 3. Luminal diameter was 7.5mm + 0.50mm. All the bitches were at estrus on day 5, with keratinized superficial cells which were anucleated with angular margins. The mean uterine luminal diameter was 8.6mm + 0.50mm. At anestrus there was reduction in the size of the uterus (5.8mm + 0.4mm). In conclusion, this study demonstrated that ultrasound can be an effective means of elucidating the estrus cycle of the bitch since there was a significant correlation between cytologic changes and ultrasonographic measurement of uterine diameter during the different phases of the reproductive cycle in Nigerian indigenous bitches.

1 Department of Veterinary Surgery and Medicine, Ahmadu Bello University, Zaria, Nigeria

2 Department of Radiology, Ahmadu Bello University Teaching Hospital, Shika, Zaria, Nigeria

Poster Session

Interrelations Between Global Climate Change And Animal Productions: Bibliographic Review

Aimable Uwizeye Mucyo

*Via Odorico da Pordenone, 35E, 95128 Catania
Italy*

The annual average temperature of the global surface increased 0.6°C during the 20th century, with important regional disparities. If the climate natural variability played a role in this evolution, the increase of the greenhouse gas concentrations in the atmosphere due to the human activities is responsible on important share and growing of the climate change reported.

The livestock subsector is one of the pollution sources of earthly origin; it contributes to the global warming by the greenhouse gas emissions and is responsible of small quantity (1%) of the carbon dioxide (CO₂), and respectively of 50 and 30% of the nitrous oxide (N₂O) and methane (CH₄). Intensive ruminants produce important quantities of these two last gasses than other monogastric animals. Several solutions aiming to reduce the greenhouses gas emissions were proposed as increase of the animal productivity (bovine) and usage the food additives (bovine, pigs) and the waste treatment. The climate change impact on animal productions risks affecting the national economies and international trade. Important sensitiveness of the livestock to climatic factors was shown in terms of feeds productions and the exposition to heat and cold.

The animals will be subjected to heat stress; consequently, the measures for the livestock systems adaptation must be taken in tropical zone, which will increase, nevertheless, the production costs provoking the increase of animal products prices. The future ways in animal husbandry in Africa reside on, one hand in further research on health and zootechnical impacts of the climate change on animals to prevent farmers and other actors of livestock to future risks, and on the other hand, in the suggestion of the adaptation measures in order to facilitate a wide responses range.

Keywords: Climate change, greenhouse gas, animal production, Africa

Comparative Responses of West African Dwarf Goats to Three Oestrus Synchronizing Agents

Oyeyemi Matthew Olugbenga, Akusu Matthew Ofierhorhe and Adeniji Deborah Adejoke

*Department of Veterinary Surgery and Reproduction
Faculty of Veterinary Medicine, University of Ibadan
Nigeria*

The comparative responses of West African dwarf goats to prostaglandin F2 alpha; sheep Veramix sponge and Sil-Estrus implant was studied. Twenty-four normo-cyclic West African dwarf does aged between 3 and 4 years weighing between 12 and 14 kg were assigned to 3 groups of eight does per group after equalization of weight. The first group was treated using Prostaglandin F2 α (Dinoprost *tromethamine*), the second group treated with Sil-Estrus implant (375mg progesterone) while the third group was treated with Veramix intravaginal sponge (60mg medroxy progesterone acetate).

Teasing the does four times daily 0800, 1200, 1600 and 2000 hours using one breeding buck per set of does carried out oestrus detection. There were reductions in weight at oestrus, which may be due to restlessness and slight anorexia normally associated with oestral period.

The interval from treatment to onset of oestrus in the three methods was 42.00 \pm 4.00 (36.00-48.00) 42.25 \pm 4.8 (36.00-48.00) and 65.75 \pm 2.01 (48.00-120.00) hours from end of treatment for Lutalyse, Sil-Estrus and Veramix sponge respectively. There was significant effect ($p < 0.05$) in the period of the day (66.67%) during which onset of oestrus was observed in the morning (am) in contrast to 25.0% and 8.33% observation for the noon and p.m periods respectively. It was also found out that oestrus duration showed that 37.5% of the oestri were of the long duration, which is significantly higher ($p < 0.05$) than the medium and very long oestrus observed to be 33.3% and 4.17% respectively. The proportion of oestrus of short duration was 25.0%.

In conclusion, the three agents and methods are suitable for synchronizing estrus in the West African dwarf goat; however the choice of either agent or method will depend on access to the drugs as well as economic consideration.

Keywords: Lutalyse, Oestrus, Prostaglandin, Sil-Estrus, WAD

The Effect of Antigen Retrieval and Incubation Methods on the Immunodetection of *Mannheimia hemolytica* in Archived Caprine Lung Tissues

Emikpe B.O^{1,2}, Akpavie S.O¹, Sabri Y.M², Zamri-Saad M²

*Department of Veterinary Pathology
University of Ibadan
Nigeria*

The diagnosis of infectious agent requires collection of high quality clinical and post mortem materials and with inefficient transport systems, the need for a technique that use archival formalin fixed samples for diagnosis is paramount. This study looked into the possible effect of two retrieval system and three methods of incubation on the immunodetection of MH antigen. Lung samples from experiment involving 15 goats inoculated with 1 ml of pure culture of a 4 hour log phase 1.0×10^9 CFU of MH serotype A2, and five goats served as controls. Nine lung tissues from each group were used for each retrieving method and these were later subdivided into three equal sets that were incubated at room temperature for five hours, 4°C for twenty four hours and 37°C for one hour, all the slides were counterstained using Haematoxylin to compare the effectiveness and intensity of immunostaining. The detection of MH antigen were more prominent and distinct in the microwave and citrate treated than that of the enzymic treatment.

All the incubation methods used detected the MH antigens with the most prominent and well distinct immunolocalisation observed in the slides incubated at 4°C for 24 hours than that of 37°C for one hour. The background staining in the room temperature 26°C slightly affect the distinctiveness of the detected MH antigen. This study corroborated that extended storage of specimens in neutral buffered formalin has no deleterious effect on MH antigens. Neither the storage period nor the enzymatic digestion as used in this study affected the demonstration of MH antigens. This result suggests that the MH antibodies used recognized epitopes that were resistant to formalin fixation and subsequent tissue processing. Incubation under the room temperature and 4°C best suit a developing economy.

1 Department of Veterinary Pathology, University of Ibadan

2 Department of Microbiology and Pathology Universiti Putra Malaysia

Blood Glucose Levels, Total Serum Proteins and Erythrocyte Indices in Three Nigerian Breeds of Cattle

Lasisi Olalekan Taiwo¹ and Isehunwa Grace Olufunmilayo²

*Department of Veterinary Medicine
University of Ibadan, Ibadan
Nigeria*

Comparison of the blood glucose levels, serum proteins and some haematological parameters in three breeds of apparently healthy Nigerian cattle of different age groups was carried out at two locations in Oyo State, Nigeria. A total of 204 cattle, comprising 134 White Fulani, 35 Sokoto Gudali and Red Bororo (respectively) breeds of both sexes, were used for the study. One Touch BasicR (LifeScan) was used to determine blood glucose levels in situ, the total serum proteins were determined using the Biuret method while red blood cell indices were determined using pocH-100iV Diff haematology system (Sysmex Animal health). The blood glucose concentration of the male calves and adult males among the Sokoto Gudali cattle was significantly ($p \leq 0.05$) higher than their counterparts in other breeds. Red Bororo heifers had significantly ($p \leq 0.05$) higher blood glucose concentration than their counterparts in other breeds. There was no significant ($p \leq 0.05$) difference in total serum proteins and red blood cell indices among the three breeds of cattle sampled. Therefore, serum glucose levels in the three breeds of Nigerian cattle can be used to determine breed, sex and age differences either in health or disease conditions.

Keywords: Blood glucose, White Fulani cattle, Red Bororo cattle, Sokoto Gudali cattle, heifers.

1 Department of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria.

2 Department of Physiology, University of Ibadan, Ibadan, Nigeria

***Brucella abortus* Antibodies in Raw Cow Milk Collected from Kraals Within the Coastal Savannah Zone of Ghana**

K.K. Addo^a, G.I. Mensah^a, K.G. Aning^b, N. Nartey^a, G.K. Nipah^c, H.L. Smits^d

Bacteriology Department

*Noguchi Memorial Institute for Medical Research, University of Ghana, Legon
Ghana*

There has been a recent upsurge in the marketing of fresh un-pasteurized milk and yoghurt in some urban areas in Ghana. This has raised concerns about human health risks associated with the consumption of unpasteurized milk especially with respect to *B. abortus* as bovine brucellosis is common in Ghana.

The Milk Ring Test (MRT) and the indirect milk ELISA were used for *Brucella abortus* antibody detection in raw milk samples collected from 224 kraals involved in the production and marketing of fresh cow milk within the coastal savannah zone of Ghana between May and July 2007 during the calving season. *Brucella* IgG and IgM lateral flow assay (LFA) was used for the detection of antibodies to *B. abortus* in whole blood from 75 herdsman and family members.

The MRT detected *B. abortus* antibodies in 21.9% of the milk samples while the ELISA detected specific antibodies in 58.9% of the samples. Two individuals (2.7%) tested positive with the LFA; one for specific IgG antibodies and the other with specific IgG and IgM antibodies.

These results indicate that although *B. abortus* antibodies are present in raw cow milk produced and marketed within the coastal savannah zone of Ghana, human brucellosis infection among herdsman and their family members is low.

Keywords: Raw milk, *B. abortus*, Kraal, MRT, ELISA

a Bacteriology Department, Noguchi Memorial Institute for Medical Research, University of Ghana, Legon

b Microbiology Department, School of Veterinary Medicine, University of Ghana, Legon, Ghana

c Epidemiology Department, Veterinary Services Directorate, Ministry of Food and Agriculture, Accra, Ghana

d KIT Biomedical Research, Royal Tropical Institute / Koninklijk Instituut voor de Tropen (KIT), Amsterdam, The Netherlands

The Economic Implications of Rumen Foreign Body Impaction in Small Ruminants in Northern Nigeria

Remi-Adewunmi, B.D¹, Olukosi, J.O², Gyang, E.O¹ and Abdullahi, U.S¹

*Department of Veterinary Surgery and Medicine
Ahmadu Bello University, Zaria
Nigeria*

Five-year records in Veterinary Clinics and slaughtered small ruminants at abattoirs in 9 Northern States and Federal Capital Territory (FCT), Abuja were examined to determine prevalence and monetary losses due to rumen impaction (RI) in small ruminants in Northern Nigeria. Livestock sellers, caterers and roasted meat (“suya”) sellers were interviewed to assess awareness of RI and obtain prices of small ruminants. Variables from these surveys were used to estimate monetary losses. In Veterinary Clinics, 5,712 (28.2%) of the 20,236 animals presented had RI. RI prevalence was highest in Yankasa sheep and Sokoto Red goats. Older female animals were more affected ($P < 0.05$). Diagnosis was confirmed during rumenotomy or at post mortem. Out of the 5,712 RI cases only 33.4% were treated by rumenotomy, 22.8% salvaged for food while 36.7% died. Peak RI prevalence was in January (21.4%) and lowest in August (0.7%). Prevalence increased continuously from 2001 to 2005. In the abattoir study, 3,948 (80.9%) sheep and 939 (19.1%) goats had rumen foreign bodies (RFB). High prevalence was recorded in Kano and Bauchi States and low prevalence in FCT and Benue States. Plastics were the most common RFB. Carcass weight of sheep (24.96 ± 7.14 kg) and goats (14.39 ± 4.16 kg) without RFB was significantly ($P < 0.05$) higher than sheep (16.43 ± 2.77 kg) and goats (9.36 ± 1.84 kg) with RFB. It is concluded that an estimated annual financial loss of over thirty-eight billion ($\text{N}38,315,689,716 = \$247,197,997$) Naira due to RI is incurred in Northern Nigeria. These are estimates from surgical treatment ($\text{N}8,005,270,451 = \$51,646,906$), poor live animals prices ($\text{N}1,574,094,119 = \$10,155,446$), poor carcass weight prices ($\text{N}3,521,755,346 = \$22,721,002$), premature culling ($\text{N}22,969,286,052 = \$148,188,942$) and mortalities ($\text{N}2,245,283,748 = \$14,485,701$). Based on results from these studies, it is recommended that government should enforce strict legislation on waste disposal plus animal confinement in towns/cities; public education through mass media; production of biodegradable packaging materials like papers and cardboards, which would not persist in the environment, or bottles and tins which can readily be recycled.

1 Department of Veterinary Surgery and Medicine, Ahmadu Bello University, Zaria, Nigeria

2 Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria, Nigeria

Multiple Births and Reproductive Problems in West African Dwarf Ewes and Does in Southern Guinea Savannah Zone of Nigeria

Zahraddeen D, Sir S.M¹, Butswat I.S.R², Naibi S.A¹ and Yande D.

Department of Animal Breeding & Physiology
College of Animal Science, University of Agriculture, Makurdi
Nigeria

Introduction

Animal management is one of the most important factors which limit sheep and goat production in Nigeria. It has been reported that the management systems of small ruminants are dictated by factors such as climate, cropping system and population density (Otchere and Kallah, 1985). Low reproductive performance of small ruminants in the north-eastern Nigeria is implicated to the traditional husbandry system practiced by most farmers in the area (Butswat *et al.*, 1998). Butswat and Bello (2002) observed that the system varies from free range grazing and browsing with little or no supplementary feeds during the cropping season. Similarly, Bayer (1986) reported that in the traditional husbandry system no special care is given to the breeding stock and hence their reproductive performance remains perpetually low.

The low reproductive efficiency of small ruminants in the tropics is influenced by factors such as breed (Butswat, 1994; Butswat *et al.*, 1998), nutrition (Malau-Aduli *et al.*, 2004), season (Butswat, 1994; Zahraddeen, 2006), Age (Akpa *et al.*, 1998), pests and diseases (Hafez, 1980; Butswat *et al.*, 2005). It has also been shown that traits such as litter size, birth weight and growth rate of off-spring from birth to weaning are indices of reproductive performance (Hill, 1988; Adama and Arowolo, 2002). Zahraddeen (2006) reported that apart from the genetic factor; diseases, seasonality of feed supply, poor management practices and low level of literacy among farmers are also responsible for the low performance of our indigenous animals. Assessment of the reproductive performance of small ruminants, especially sheep and goats with respect to the occurrence of multiple births and reproductive problems in these species managed under small-holder husbandry system is practically non-existent in literature in the study area. This study was therefore undertaken to investigate the factors responsible for the differential multiple birth and reproductive problems in the two species in Gboko Area of Benue State, Nigeria.

Materials and Methods

This study was carried out in Gboko Area of Benue State, Nigeria (October, 2004 – September, 2005). The area is situated in the southern guinea savannah ecological zone of Nigeria. The mean annual rainfall is about 1280-1367 mm, which influence greatly the amount of pasture and fodder in the area to suit small ruminant production (Kowal and Knabe, 1972). A total of 293 animals were used (120 sheep and 173 goats) for the on-farm study, which lasted for 12 months (October, 2004 to September, 2005). The season in Nigeria is divided into four based on the rainfall distribution pattern (Butswat, 1994). These are: - the early dry (October - December), late dry (January - March), early rainy (April - June) and late rainy (July - September) seasons.

The breeds of sheep and goats used for the study were the West African Dwarf types, which were the predominant breeds of these species in the study area. The detailed descriptions of these breeds have been reported by Adu *et al.* (1979). The animals used were from small-holder farms. The farmers practiced the traditional husbandry system and this ranges from free-range grazing and browsing to little or no supplementary feeding during the cropping period. The animals were sometimes given rudimentary health care, but in most cases not dewormed. Data were recorded on cases of multiple births (singles, twins, triplets and quadruplets) and on some incidence of reproductive problems (dystocia, retained placenta, mastitis, metritis and neonatal infections). Data were generated through on-farm visits, veterinary clinics and other relevant information were collated through oral interview. The data were classified based on location, species and season of the year. Data generated were subjected to simple descriptive statistics and chi-square test as described by Humburg (1977).

1 Animal Production Programme, School of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, PMB 0248, Bauchi, Nigeria

2 National Open University of Nigeria, Jos Study Centre, Jos, Nigeria

Results

Data on the influence of species on multiple births are presented in Table 1. The results showed that the incidence of singles, twins, triplets and quadruplets were significantly ($P < 0.05$) different between the two species; values being 51.9 vs 48.1, 62.0 vs 38.0, 72.5 vs 27.5 and 55.0 vs 45.0 % for does and ewes respectively.

Table 1: Influence of species on occurrence of multiple births in ewes and does

Litter size	Does	Ewes	Overall	X ²	Los
Singles	95(51.9)	88 (48.1)	183		
Twins	88 (62.0)	54 (38.0)	142		
Triplets	37(72.5)	14 (27.5)	51	7.82	*
Quadruplets	11 (55.0)	9(45.0)	20		

* $P < 0.05$, Figures in parenthesis are percentages, Los = Level of significance

Table 2: Influence of season on occurrence of multiple births in sheep and goats

Litter size	Early dry	Late dry	Early wet	Late wet	Overall	X ²	Los
Singles	52(28.4)	38(20.8)	61(33.3)	32(17.5)	183		
Twins	31(21.8)	42(29.6)	40(28.2)	29(20.4)	142	16.92	NS
Triplets	18(35.3)	14(27.5)	9(17.6)	10(19.6)	51		
Quadruplets	8 (40.0)	4(20.0)	4(20.0)	4(20.0)	20		

NS = Not significant at 5 %, Figures in parenthesis are percentages, Los = Level of significance

Table 2 shows the influence of season on multiple births in these species. The results revealed non-significant difference in the birth of singles, twins, triplets and quadruplets with respect to season of the year. However, the incidences of some reproductive problems (dystocia, retained placenta, mastitis, metritis and neonatal disease) as influenced by the species are presented in Table 3. The results showed cumulative incidence of these problems differed significantly ($P < 0.001$); with does having higher cases than in the ewes and the early wet having the highest cases followed by early dry then late dry and lowest in the late rainy season. There was no significant effect of these problems with respect to location of the study area.

Discussion

The present investigation observed significantly higher cases of multiple births in does than in ewes. This difference may be attributed to genetics and environment. Peacock (1996) reported that goats reproduce very fast with tropical breeds having higher traits for producing twins and triplets. This was similarly reported by Ola and Egbunike (2005) that multiple births were common in goats; with the young doe giving birth to one kid initially and subsequently they start to give birth to twins and triplets. However, the difference may also be linked to difference in feeding habits between the two species. For instance, the goats are able to utilize or feed on less quality feedstuff, and this is an adaptation for the goat species to maintain their body tissue reserves fairly constant for normal physiological functions, even in areas or season of feed scarcity. Similarly, goat is considered superior to other ruminant animals in its utilization of poor quality and high fiber forages, they also have important drought survival strategy in marginal cropping areas where mixed farming is prevalent (Dominique *et al.*, 1991; Doma *et al.*, 1999). This present investigation was also in conformity with the observation made by Butswat (1994) that continuous maintenance of doe and ewes in average condition neither too high nor too low will maintain high ovulation rate. High ovulation rate is a reflection of number ova to be brought to fertilization, which may influence the occurrence of multiple births in both species. Therefore, these genetic and environmental factors aforementioned are mainly the reasons for the variation in the prolificacy of the two species.

The non-significant seasonal effect in multiple births between the species disagreed with the reports of Zahraddeen (2006)

Table 3: Influence of species, location and season on occurrence of reproductive problems in doe and ewes

	Dystocia	Mastitis	Metritis	Neonatal disease	Retained placenta	Cumulative incidence	X ²	Los
<i>Species</i>								
Does	70 (73.7)	34(54.8)	29(69.0)	52(46.4)	27(61.4)	212	9.49	***
Ewes	24(26.3)	28(45.2)	13(31.0)	60(53.6)	17(38.6)	143		
<i>Location</i>								
Yandev	21(22.1)	11(17.7)	4(9.5)	22(19.6)	5(11.4)	63		
Ipav	18(18.9)	12(19.4)	10(23.8)	23(20.5)	9(20.5)	72		
Mbayion	18 (18.9)	13(21.0)	6(14.3)	18(16.1)	10(22.6)	65	26.30	NS
Mbatyav	16(16.8)	18(29.0)	6(14.3)	26(23.3)	12(27.3)	78		
Mbatyerev	22 (23.3)	8(12.9)	16(38.1)	23(20.5)	8(18.2)	77		
<i>Season</i>								
Early dry	23(26.7)	18(29.0)	13(23.2)	24(21.4)	15(35.1)	102		
Late dry	17(19.8)	16(25.8)	9(16.1)	34(30.4)	10(22.7)	86	21.03	***
Early wet	29(33.7)	20(32.3)	14(25.0)	34(30.4)	12(27.3)	109		
Late wet	17(19.8)	8(12.9)	20(35.7)	20(17.8)	7(15.9)	72		

NS = Not significant, *** $P < 0.001$, Figures in parenthesis are percentages, Los = Level of significance

who stated that in goat litter size was seasonally influenced; with higher value in the wet than dry season. The lower litter size in the dry season might have been due to excessive ambient temperatures and unavailability of feed during the season especially late dry season as had been explained by Butswat (1994). However, the disagreement between the two studies might have been linked to differences in the weather parameters in the two study areas. The present study was carried out in southern guinea savannah, which is characterized with abundant feed supply, more friendly weather conditions as in the sudan savannah zone of Nigeria, where the former investigation was conducted.

The study observed significant difference in cumulative incidence of reproductive problems in ewes and does; with higher incidence in the does than in ewes. This difference is probably accountable to the effect of the rainy season, which the goat species finds unfriendly to their comfort and survival as a result of the incessant rainfall. Unlike the goat species, sheep are more tolerable to wetly environment than goats especially managed under the free-range system. For instance, Zahraddeen *et al.* (2007) reported that goats performed best in the early dry season followed by the late dry and early rainy seasons and lowest in the late rainy season. Similarly, Vandeplassche (1982) and Abdullahi (1999) observed that some cases of reproductive problems arose consequent to secondary genital tract infections which are aggravated by poor management and inadequate nutrition. This has also been supported by Petters and Ball (1995) who observed that dietary deficiencies, especially of vitamin E and selenium have been known to cause retained placenta.

However, the seasonal effect observed in the present investigation with respect to incidence of reproductive problems in does and ewes is in conformity with the findings of Zahraddeen *et al.* (2007) who reported higher cases in the wet season and attributed this to cropping activities and higher incidence of pests and diseases which resulted in the imposition of restriction on the animals. The non-significant difference observed in the present investigation with respect to occurrence of reproductive problems in the five locations studied is attributed to uniform management employed in the rearing of these animals by the local farmers. The management of these animals is characterized by low managerial input supply and hence the productivity of the animals is at stake.

Conclusion

This study concludes that the incidence of multiple births in does and ewes is fairly good compared to the level obtained in these species elsewhere. Also, the high incidence of reproductive problems is mainly attributed to the low level of nutrition

in animals generally managed under the small-holder husbandry system in the area. However, this study suggests that improvement in the management practices will greatly enhance multiple births in both species and reduce the incidence of these problems in the study area.

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Helmenthosis in Domestic Ruminants raised under the Semi-Intensive System in Part of Northern Guinea Savannah Ecological Zone of Nigeria

Zahraddeen D, Butswat I.S.R¹ and Adamu U²

Department of Animal Breeding & Physiology
College of Animal Science, University of Agriculture, Makurdi
Nigeria

Introduction

In Nigeria, ruminant (cattle, sheep and goats) production has been characterized by low productivity in some indices such as growth and lactation performance, with very low kid/lamb survival rates (Zahraddeen *et al.*, 2007a). This reduced performance has been implicated to several factors such as poor nutrition (Osinowo and Adu, 1985), heat stress (Butswat *et al.*, 2000), genotype (Butswat *et al.*, 1998), pests and diseases (Butswat *et al.*, 2005). Butswat (1994) reported seasonal differences in reproductive status of sheep and goats in Bauchi. This worker attributed the variations mostly to seasonal differences in feed availability and quality. Zahraddeen (2006) reported that in the traditional livestock husbandry system no special care is given to the breeding stock and this has resulted in reduced reproduction. Therefore, assessment of the problems of ruminant production will go a long way towards addressing the common problems of low productivity generally encountered among farmers, thereby curtailing the current animal protein shortage in the country.

In Nigeria and other developing nations, helmenthosis is one of the major diseases which cause considerable livestock mortality and colossal financial and economic losses (Butswat *et al.*, 2005). Helmenthosis is an infection of an animal host with parasitic worms known as helminthes. This disease is prevalent and caused serious economic problem to livestock such as cattle, sheep, goats, horses, poultry, swine and other farm animal species. It is also a serious health risk to human and companion animals such as dogs, cats and other pets (Winkler, 1982). It has been estimated that gastro-intestinal helmenthosis in sheep and goats causes losses up to 60 million annually (Akerejola *et al.*, 1979). It has been reported that in a number of countries where mortality rate of young stock in their first year of life may reach 40 to 50%; at least half of these losses can be attributed to helmenthosis. In addition, helmenthosis causes retarded growth and loss of weight in livestock (Finelle, 1999). In Africa, where the great majority of herds are managed traditionally and often heavily infected the losses may be considerably higher. Helmenthosis can also cause severe damage to the walls of the intestinal tract, tissues and organs, and if left untreated may result in death of the infected host animal. However, infected livestock will exhibit poor production performance as manifested by little or no weight gain and metabolic disturbances.

In Nigeria, there are various systems of rearing animals employed by the local farmers. Butswat and Bello (2002) reported that the management system is mostly traditional and this ranges from free-range grazing and browsing with little or no supplementary feeding during the non-cropping period to tethering with zero-grazing during the cropping season. Butswat *et al.* (2005) reported high infection rates of helmenthosis in sheep and goats managed under the extensive system of production. It is therefore imperative to investigate the prevalence rate of this disease in herds/flocks of domestic ruminants reared under the semi-intensive system of livestock production. It on this basis this study was designed to investigate the level of infection of helmenthosis in these animals in Bauchi, a part of northern guinea savannah ecological zone of Nigeria.

Materials and Methods

Location and climate

Bauchi, the study area, apart from being the State capital and headquarters of Bauchi Local Government, is also the

1 National Open University of Nigeria, Jos Study Centre, Jos, Plateau State, Nigeria

2 Animal Production Programme, School of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, PMB 0248, Bauchi, Nigeria

urban centre in the State. It lays on latitude 10° 17' north, longitude 8° 49' east and at an altitude of 690.2 metres above sea level in the Northern Guinea Savannah ecological zone of Nigeria (Kowal and Knabe, 1972). The climate is suitable for agriculture and is marked with two distinct seasons; dry and rainy (October – March and April to September, respectively) (Butswat, 1994). The annual rainfall is between 1016-1270 mm. The mean monthly hours of sunshine is highest in December (300.3h) and lowest in August (150.1h). April is the hottest month with mean maximum and minimum temperatures of 30.1 and 13.7 °c respectively. The mean relative humidity is highest in August (74.0%) and lowest in February (16.5%) as reported by Butswat *et al.* (2000).

Soil and Vegetation

The soils and vegetation of Bauchi have been previously described by Butswat *et al.* (2000). Ferruginous (Haplustalf) soils on sandy parent materials are common. They are generally considered to be of high fertility. However, their susceptibility to erosion and drought has limited their maximum utilization for crop production. The vegetation is open savannah woodland with trees up to 6 metres or more. The trees normally occur singly or in clusters, while the spaces between are occupied by non-woody species up to 3 metres high. The effect of cultivation and burning has reduced the vegetation in many places to Acacia shrubs. Grasses in such areas normally reach a height of 3.5 metres or more. These grasses are generally brown and have low nutritive value during the dry season. With the onset of the rainy season, however, there is lush pasture which has higher nutritive value.

Source of data

The domestic ruminants (cattle, sheep and goats) used in the study were those kept at the Research Farm of Abubakar Tafawa Balewa University, Bauchi, Nigeria. The Bunaji was the cattle breed used. The predominant sheep in the Farm was Yankasa and few other breeds such as Uda and their crosses may be occasionally seen. The commonest goat breed was Red Sokoto and other breeds such as Sahel and Kano Brown and their crosses were also sparsely available. The detailed descriptions of these species and their breeds have been reported by Osinowo (1990). These animals were raised under the semi-intensive system of husbandry. In the night, they were kept in cross-ventilated pens within the animal house, but allowed to graze during the day time within the University premises. They were supplemented with mineral licks and concentrate feeds. At times, they were also fed groundnut haulms. Routine health care such as vaccination/medication, ectoparasite control and deworming were also regularly carried out. Fresh drinking water was provided *ad libitum*.

Data collection

The data for this study were collected over a period of one year (April, 2007 to March, 2008). The fresh faecal samples collected from randomly selected animals were subjected to laboratory analysis using simple floatation test and those identified to be infected with helminthes were recorded as per the procedures described by Hensen and Brian (1990). A total of one hundred and eighty (180) samples were used for the study; 40 each from cattle, sheep and goats. Samples were classified based on species, age, sex and season.

For the purpose of this study, the age was grouped into three; young, adult and old. In cattle, the young were d' 3 years, > 3 to d' 6 years as adults and old as > 6 years. For goats and sheep; < 24 months was taken as young, 24 to d' 48 months as adults and > 48 months as old animals. The dentition method was used for the aging.

Data analysis

The data generated were subjected to simple descriptive statistics (means and percentages) and chi-square test were used to describe factors such as species, sex, age and season, as described by Humburg (1977).

Results

Data on the prevalence of helmenthosis in domestic ruminants (cattle, sheep and goats) as influenced by species, age, sex and season are presented in Tables 1 and 2. The results showed that infection rates with regard to species, sex, age and season did not differ significantly in all the animals studied. For instance, the infection rates were 5.0, 7.5 and 5.0% for cattle, sheep and goats, respectively, and did not differ significantly. The effect of sex on infection rates were 3.3 and 8.3% for male and

female animals, respectively. There was also no significant difference in the rate of infection among animals of different ages; the young, adult and old animals had infection rates of 3.3, 6.7 and 13.3%, respectively. Similarly, the influence of season on the rate of helminth infection did not differ significantly among the four seasons (early wet, late wet, early dry and late dry) studied. Their respective values of infection were 13.3, 6.7, 0.0 and 3.3%.

Table 1: Prevalence of helmenthosis in ruminants as influenced by species and sex in Bauchi

	Number observed	Number infected	Infection rate (%) X ²	Los	
<i>Species</i>					
Cattle	40	2	5.0		
Sheep	40	3	7.5	0.859	NS
Goats	40	2	5.0		
<i>Sex</i>					
Male	60	2	3.3	0.243	NS
Female	60	5	8.3		

NS = Not significant at 5 %, Los = Level of significance

Table 2: Prevalence of helmenthosis in ruminants as influenced by age and season in Bauchi

	Number observed	Number infected	Infection rate (%) X ²	Los	
<i>Age</i>					
Young	40	1	3.3		
Adult	40	2	6.7	0.346	NS
Old	40	4	13.3		
<i>Season</i>					
Early wet	30	4	13.3		
Late wet	30	2	6.7		
Early dry	30	0	0.0	0.151	NS
Late dry	30	1	3.3		

NS = Not significant at 5 %, Los = Level of significance

Discussion

This study exhibited non-significant differences with respect to helminth infections as influenced by sex, age, species and season when ruminants were raised under the semi-intensive system. The non-significant differences observed in the study might have been due to effective helminth control measure subjected to these animals. The Farm being owned by a university, it is expected that the level of disease control and prevention should be high. Butswat *et al.* (2005) reported significant differences in the infection of helminths in sheep and goats with respect to period, sex, species and season in the same study area. This variation might have been attributed to differences in the rearing method in the two studies. In the latter, the animals were raised under the extensive system, which requires no managerial inputs since animals are allowed to roam freely and fend for themselves, and breeding is done indiscriminately. Butswat *et al.* (2005) reported that helminth infections were at the increase in Bauchi and attributed it to increased livestock production and lack of knowledge on deworming. Gefu (1994) reported that inadequate housing predisposes animals to diseases and possibly facilitate the spread of other contagious diseases such as *peste des petit ruminants*. This was similarly reported by NAERLS (1990) that improper or unsuitable housing condition predisposes animals to pests and diseases. Tick and worm infestations were the major constraints of sheep and goat farming under the small-holder husbandry system, as reported by Doma *et al.* (1999), which occurred all-year round with high incidence rate in the dry season. These infestations affected both the young and mature stock, which depict irregular vaccination/medication programmes in their upkeep (Zahraddeen *et al.*, 2007b).

However, works on helmenthosis using domestic ruminants gave various results. For instance, the present investigation agrees with the reports of Umoh *et al.* (1982) and Orokpo (1991), who obtained non-significant differences with respect to infection rate of helmenthosis in ruminants. Conversely, Peacock (1996) and Butswat *et al.* (2005) reported significant differences in the prevalence rate of the disease in the same study area among goats and sheep kept under the extensive/free-range system. Opasina (1985) also reported significant differences in the infection rate in herds/flocks of cattle and sheep reared in humid zone of Nigeria. Other workers who reported significant differences in their studies on helmenthosis were Vegors *et al.* (1971) and Knight *et al.* (1972), but the effect of environment and helminth control measure seem to be in place. However, the difference between the two groups (significant versus non-significant) in their helminth infection primarily lays on the use of control measure in rearing the animals. It is expected that animals reared under the extensive system should have higher infection rate as compared to their counterparts raised under improved management conditions, since the system encourages animals to roam freely and fend for themselves. Animals' performance is perpetually low under this system of production, as there is no provision of any care to the breeding stock. Unlike the semi-intensive system which entails the use of managerial inputs in raising animals. The ultimate goal of any farmer in keeping animals is to supply him with meat, milk, eggs, hide and skin, and other important by-products necessary for his sustenance.

Conclusions

The study concludes that there was minimal helminth infection in ruminants managed under this system, but farmers should gear in their efforts towards provision of improved management conditions to their livestock; in terms of good housing, regular use of antihelmintics, adequate nutrition, among others so as to enhance the purpose to which they are kept on the farm.

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Correlation of Body Length with Sonographic Measurement of Bipolar Length Kidneys of Nigerian Indigenous Dogs in Zaria, Nigeria

Lawal M¹, Musa A.S, Hassan A.Z¹, Remi-Adewunmi B.D¹, Abdurrahman M¹. Chom N.D², Men N³, Mustapha R.A¹, Audu S.W¹, Munir A.S¹, and Andrew A.

*Department of Veterinary Surgery and Medicine
Ahmadu Bello University, Zaria
Nigeria*

Introduction

Ultrasonography is widely applied to detect the presence of normal and abnormal structures and morphological changes in solid organs and is useful to narrow down the differential diagnosis (Walter et al 1987, Osborne and Finco 1999). Ultrasonographic evaluation is especially useful for assessing kidneys because important anatomic information concerning the size, shape and internal architecture can be obtained even in the presence of impaired renal function or abdominal fluid (Armbrust et al 2001). Compared to conventional survey radiology, ultrasonography can better visualize kidneys in emaciated animals and those with retroperitoneal fluid. Sub-capsular fluid, localized perirenal fluid, small renal or perirenal masses and pelvic or ureteral dilation can be also easily detected in ultrasound. Ultrasound-guided interventional procedures and Doppler ultrasound imaging enables us to better assess renal function/status (Platt 1992).

Deeper structures such as kidney and liver are imaged at lower frequency 1-6MHz with lower axial and lateral resolution but greater penetration medical ultrasonography is used in, for example, Cardiology, endocrinology, gastroenterology, emergency medicine many assessment which includes the focused assessment with sonographic for trauma (FAST) examination for assessing significant hemoperitoneum or pericardial tamponade after trauma (Woo, Joseph 2002). Gynecology, neurology: for assessing blood flow and stenoses in the carotid arteries and the big intracerebral arteries. Obstetrics ultrasonography, ophthalmology using A and B ultrasonography, urology to determine for example the amount of fluid retained in a patients bladder. Musculoskeletal, tendons, muscles, nerves, and bones surfaces. Intravascular ultrasound example ultrasound guided fluid aspiration, fine needle aspiration, guided injections. Interventional: biopsy, emptying fluids, intrauterine transfusion (hemolytic diseases of the new born) contrast enhanced ultrasound (Woo, Joseph 2002). The two kidneys lie in the back of the abdominal wall but not actually in the abdominal cavity. They are retroperitoneal, meaning they are just behind the peritoneum, the lining of this cavity (Arthur, et al 2001). They lie on either side of the vertebral column, just below the diaphragm. They lie in depressions against the deep muscles of the back (Sylvia, 2002). They are buried in a mass of fat. The left kidney is usually placed a little higher than the right (Basmajian, 1964).

This study was conducted to correlate body length with sonographic measurement of bipolar length kidneys index with the view of using these for estimating kidney size as an adjunct to diagnosis and treatment decisions concerning renal diseases.

Materials and Methods

Fifty one matured Nigerian Indigenous breeds of dogs were used to conduct the research. These consisted of nineteen dogs (37.3%) and thirty two bitches (62.7%). Portable ultrasound machine (medison SA-600v), 3.5MHz transcutaneous transducer (sonde Korea C5-B), ultrasonic aqua gel, weighing balance, measuring tape, tissue paper, thermal printer, thermal printing papers, examination table and muzzle (mouth Restrainer).

The length of each dog was measured from the point of the muzzle to the base of the tail, using a good string and a measuring tape. The ventral abdominal hair coat was clipped to prevent the hair coat interfering with the image displayed on the monitor (as this will cause pockets of air to collect between the probe and the skin, thereby blurring the image).

1 Department of Veterinary Surgery and Medicine, Ahmadu Bello University, Zaria, Nigeria

2 Department of Radiology, Ahmadu Bello University Teaching Hospital Shika, Zaria, Nigeria

3 Department of Veterinary Anatomy, Ahmadu Bello University, Zaria, Nigeria

Ultrasound scan was performed using a static B-mode articulated scan arm and a 3.5 MHz transducer (Sonde Korea C5-B). The longitudinal axis of the left kidney is usually located with the cranio-lateral surface in contact with the dorsal end of the medial surface of the spleen and curvatures of the stomach. The right kidney has its cranial pole usually embedded in the fossa of the lobes of the liver. Moving the transducer up the down, lateral and medial helps to centralize the beam on the kidney on B-mode. A longitudinal image of the kidney is obtained, with the cranial pole and extreme caudal pole displayed on the monitor. The maximum bipolar length was then measured and the procedure repeated for each kidney and an average gotten.

Results and Discussion

The result of the body length measurement showed the dogs to have a body length ranging from 59-103 cm with a mean body length of 87.04 ± 9.2 cm. The bipolar measurement of the kidneys showed the measurement taken ranged from 39- 66 mm and 41-65 mm in diameter with the mean length of the kidneys being 53 ± 5.81 mm and 53.02 ± 4.99 mm for the left and right kidneys respectively (Plate 1; Fig 1 & 2).

The body length and length of left kidney was analyzed and a correlation of 0.611 which has a significant data of 0.000 ($P < 0.05$). This implies that there is a significant correlation between the body of length and length of left kidney. $T = 33.290$ which has a significance of 0.000 (2- tailed test) and $P < 0.05$. Similarly comparison between the body length and right kidney also showed a significant correlation. As kidney length correlated with body indices (length and weight), it is suggested that this body index (length) is a useful and simple method of estimating kidney size as an adjunct to treatment decisions

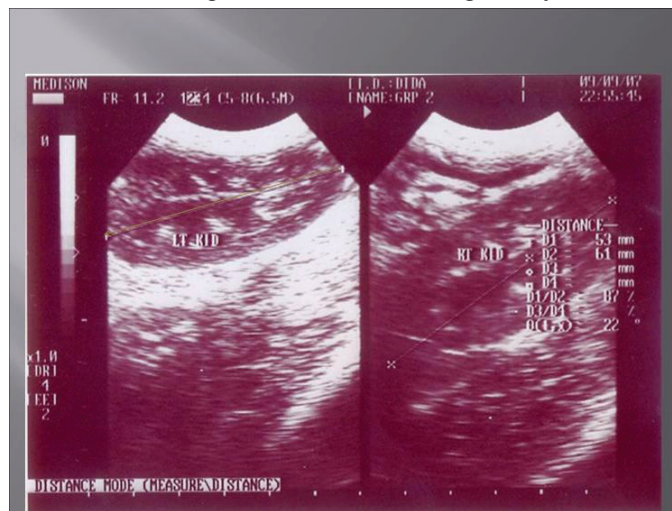


Plate 1: Sonograph of a left (LT) and right (RT) kidneys of a dog, with bipolar measurement of 53 and 61 mm respectively.

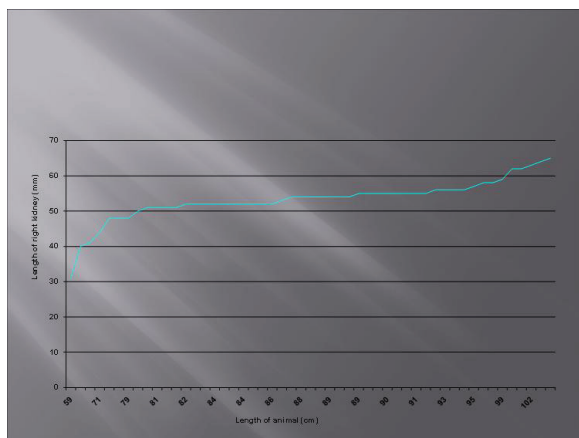


Figure 1. Correlation between body length and the bipolar length of left kidney of dogs.

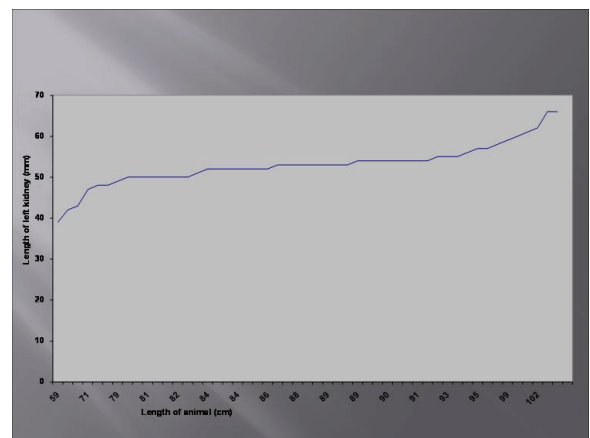


Figure 2. correlation between body length and the bipolar length of right kidney of dogs.

concerning renal diseases (Edell S L *et al* 2004). The results of this study agree with the findings in another study, kidney length correlated best with human body height (Emamian S A, *et al* 1993).

Conclusion

This study concluded that kidney length correlated with this body index (body length) in Nigerian dogs may be of assistance for estimating kidney size during clinical assessment of patients as this gives an early indication to the condition of the kidney. It is therefore recommended that this simple body index is useful for estimating kidney size as a quick diagnostic tool for renal diseases which is non-invasive as compared with other diagnostic procedure such as urography.

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Effects of *Amblyomma Variegatum* Sialidase on the Erythrocyte Ghost and Brain Cells of Different Animal Species

Natala, A.J¹, Nok, J.A³; Balogun, O.E³, Agbede, R.I.S¹ and Esievo K.A.N²

Department of Veterinary Parasitology & Entomology
Ahmadu Bello University, Zaria
Nigeria

Cleavage of sialic acid from the erythrocyte surface by sialidases has been widely reported especially in *Trypanosoma Species*. It is believed that neuraminidase activity increase proportionately with increase in the number of trypanosome. It has also been suggested that the trypanosome might be producing neuraminidase *in vivo* during infection which might cleave off erythrocytes more prone to phagocytosis, either directly by immunoglobulin and complement opsonization or indirectly through the exposure to B – galactose – specific lectin on surface of macrophages. There has also been suggestion that anaemia in cowdriosis could be from acute blood loss, acute haemolysis, sequestration of red blood cells in spleen, haemodilution or bone marrow depression. However, evidences to these claims have not been substantially validated. The results from this study could give some clues to the understanding of the precise cause of anemia in cowdriosis and the possible mechanism of movement of Cowdria organisms to the brain endothelium. Engorged ticks were carefully removed from cattle on the field in Zaria, Nigeria, cleaned and put in the incubator, where they hatched and subsequently molted to larvae and nymphs. Ten Kano Brown goats were used for tick feeding. Six goats had the hairs around the bases of their ears shaved, for the attachment of ear bags, (containing larvae and nymphs) with the aid of plaster. The remaining had their flanks clipped of hairs and used for the feeding of adults. Thus, fed and unfed larvae, nymphs and adults were harvested. Preparation of crude tick extract was done using 2grams of each of the stages of *Amblyomma variegatum*. The supernatant were referred to as the crude enzyme. Fractionation of crude tick extract by chromatography was conducted using six columns (1ml each). The crude tick extract from various crushed tick stages were loaded (1ml each) onto the cellulose columns. Sodium chloride gradient (1–50 mM NaCl in acetate buffer, pH 4.0) was prepared and used for the elution from the DEAE – cellulose column. Plasma/buffy coat obtained from blood of domestic animals and the enzyme activity liberated was assayed. Effect of *Amblyomma variegatum* sialidase on the brain of domestic animals was carried out immediately after being sacrificed and the skulls were split open to collect the cerebellum and incubated with *Amblyomma variegatum* eluate. Result obtained from the incubation of erythrocytes with the enzyme, revealed that there was high cleavage of sialic acid from the erythrocyte ghost cells of ruminants (cattle, sheep and goats). The differences between that of ruminants and non-ruminants was statistically significant ($P<0.05$). Among the ruminants, the level of activity was in the order cattle>sheep>goats, while in the non-ruminants, is in the order dog>guinea fowl>chicken>horse>pig. When brain cells were used as substrate, there was extensive cleavage. The sialidase activity in the brain of sheep, cattle, goat, and mice were quite higher than in cat, dog, rabbit and guinea pig. Those of ruminants were much higher than the non-ruminants. In the ruminants, the activity was equal in cattle and goat, but less in sheep. In non ruminants, it was in the order mice>guinea pig>rabbit>cat>dog. *Amblyomma variegatum* sialidase assayed with the use of erythrocyte ghosts and brain cells of different animals as substrate revealed a high specificity for ruminants' cells, while cells of non-ruminants are relatively poor substrate. The difference between the activity of the enzyme in the ruminant and non ruminant was statistically significant ($P<0.05$). The sialidase activity with the brain cells of mice was significantly ($P<0.05$) high, compared with other non-ruminants. This study showed that the erythrocytes ghost cells in ruminants are due to sialidase cleavage by the *Amblyomma variegatum* being the cause of the anemia. There was also a significant cleavage by sialidase released by the tick with brain cells in ruminants; this is probably why cowdriosis is seen only in ruminants.

1 Department of Veterinary Parasitology & Entomology, Ahmadu Bello University, Zaria, Nigeria.

2 Department of Veterinary Pathology and Microbiology, Ahmadu Bello University, Zaria, Nigeria.

3 Department of Biochemistry, Ahmadu Bello University, Zaria, Nigeria.

Radiographs of Limb Conditions of Dogs, Cats, and Horses, Presented to Radiology Unit of Ahmadu Bello University Veterinary Teaching Hospital Zaria, Nigeria (1999-2008)

Abdurrahman, M¹, Enejoh, O¹, Lawal, M¹, Remi-Adewunmi, B.D¹, Mustapha, R.A¹, Abidoye, E.O¹, Emmanuel, E.G², Audu, S.W¹ and Sani, M.A¹

*Department of Veterinary Surgery and Medicine
Ahmadu Bello University Zaria
Nigeria*

Introduction

Radiography (diagnostic radiology) refers to the use of X-rays for the visualization of internal structures portrayed on an X-ray film or a screen (fluoroscopy). (Hassan, 2003). Radiography is one of the most useful diagnostic tools in Veterinary Medicine for the detection and diagnosis of suspected musculoskeletal disease. Radiographs permit localization and characterization of a lesion, which together with the animal's history, clinical signs, and physical and laboratory findings are used to achieve a tentative or specific diagnosis (Hassan 2003).

Over one-half of all diagnostic radiographic studies in dogs are of the bones and joints of the legs (Joe, 1988). In the young growing dog, radiographic examinations frequently are used to evaluate lameness and pain due to developmental bone disease. The acutely injured animal following trauma must be examined for suspected fracture while the older animal that is increasingly unwilling to use a leg is examined for degenerative or secondary disease (Morgan, 1988). The extremities of animals are examined radiographically more often than any other parts of the body (Carson, 1961).

Skeletal surveys in small animals are commonly used to diagnose orthopedic diseases such as hip and elbow dysplasia, fractures, osteochondrosis desicans, panosteitis, tumor, congenital anomalies and also for radiographic studies of the knees and forelegs of horses for soundness examination (Morgan, 1972). The role of radiographic examination in large animal patients is limited to confirming the presence, extent and severity of osseous lesions that have been predetermined by visual and manipulative examinations and localized by segmental nerve blocks (Gyang, 2002). In the horse, radiographic examination of the limbs is indicated for several conditions.

Indications for radiographic examination of the foot in the horse includes laminitis, navicular disease, fracture of the navicular bone, third phalanx and arthritis of the coffin joint (Hanlon, 1982, Adams, 1977). Conditions requiring examination of the fetlock are sesamoiditis, fracture of the proximal sesamoids, chip fracture of the cannon bone or first phalanx, ring bones and arthritis of the metacarpophalangeal joint (osselets) (Praser, 1971, Krpan and Crawky, 1986). The carpal joint is a common seat of lameness condition; therefore radiographic examination of the joint is indicated for fractures, osteochondrosis and arthritis (Burguez, 1984). Radiographic examination of the hock in horse is spavin. Chip fractures involving trochlea of the Tibiotarsal bone do occur (Gyang, 2002).

Radiographic description of fracture is based on: the type of fracture which include: compound (open) fracture, simple (closed) fractures, oblique, spiral fracture, multiple fracture, comminuted, chip, impacted, greenstick, avulsion, saucer fractures (Leonard, 1971, Slatter, 2003) or on the bases of location, fracture could occur at proximal one-third, mid-shaft, distal one-third of the Diaphyseal bone or on the epiphysis, metaphysis and the condyles of long bones. (Leonard, 1971). Fracture of the bone can also be described as complete or incomplete depending on the degree of the fracture (Frank, 1964). Trauma is the common cause of fracture in small animals and large ruminants and it is usually caused by direct impact (Philip, 2008).

Materials and Methods

The research was carried out in the radiology unit of the Ahmadu Bello University Veterinary Teaching Hospital, Zaria

1 Department of Veterinary Surgery and Medicine, Ahmadu Bello University Zaria

2 Veterinary Teaching Hospital, Ahmadu Bello University Zaria

(11°10'N 0738'E) located in the Northern Guinea Savanna Zone of Nigeria. Samples were drawn from the available radiographic data for the period of ten years (1999 – 2009) from the radiology unit of the department of Veterinary Surgery and Medicine, Ahmadu Bello University, Zaria. The samples were analyzed to determine the types and the prevalence rate of radiographic limb conditions with more emphasis on limb fractures in dog, cat and Horse in Zaria and its environs.

Results

- Limb conditions observed generally are on Table 1.
- Fracture 151 (43.1%), Elbow luxation 6 (1.7%), Hip dysplasia 11 (3.1%), Patella luxation 1 (0.3%), Tibiotarsal luxation 4 (1.1%), Soft tissue swellings 44 (12.6%), Exostosis of the 3rd phalanx 7 (2%), Low ring bone 2 (0.6%), High ring bone 3 (0.9%), Calcified flexor tendon 4 (1.1%)
- Congenital abnormalities 7 (2%), Carpalis 3 (0.9%), Rupture of the superficial digital flexor tendon and deep digital flexor tendon 2 (0.6%).
- Fracture cases have the highest prevalence (43.1%) and occurred mostly in dogs (90%), followed by Horses (5.3%) and Cats (4.7%). FIG 1
- Hind limb fractures occurred more than forelimb in dogs and cats and represented a ratio of 5:1. The reverse however, was the case in horses.
- Midshaft transverse diaphyseal fractures had the highest prevalence, followed by oblique fractures and were related to automobile accidents.
- The femur and tibia is the most commonly fractured in dogs and cats
- In the horse however, the commonly fractured bone are the sesamoid bones.
- Most of the fracture cases in dog were due to road traffic accidents (RTA) because owners of these animals allow them to roam around.

Discussion and Conclusion

- The occurrence of fractures in dogs and cats can be attributed to the way these animals are kept by the owners. Dogs and cats are often allowed to roam about from house to house and from one street to the other without any regulatory

Table 1: Radiographic limb conditions of Dog, Cat, and Horse presented to ABUVTH, ZARIA, (1999-2009).

Limb Conditions	Dog	Cat	Horse	Total
Fractures	137	6	8	151
Elbow Luxation	6	0	0	6
Hip Dysplasia	11	0	0	11
Patella Luxation	1	0	0	1
Tibiotarsal Luxation	4	0	0	4
Soft Tissue Swellings	0	0	44	44
Exostosis of the 3 rd Phalanx	0	0	7	7
Low Ring Bone	0	0	2	2
High Ring Bone	0	0	3	3
Calcified Flexor Tendon	0	0	4	4
Congenital Anomalies	6	1	0	7
Rupture of the SDFT and DDFT	0	0	2	2
Carpitis	0	0	3	3
Normal Radiographs	88	6	11	105
Total	253	13	84	350

SDFT Superficial digital flexor tendon

DDFT Deep digital flexor tendon



Plate 1: A Vento-dorsal radiograph view of the pelvic girdle of a 18 month-old terrier bitch. Note: (arrow) showing the femoral neck fracture. (B) Showing the femoral shaft. (A) showing complete fracture of the distal 1/3 of the femur.

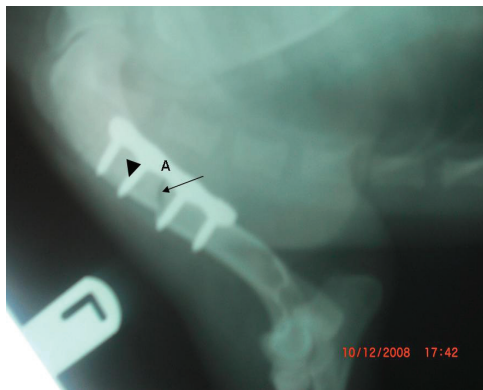


Plate 2: Lateral radiograph of the left hind limb. Note (Circle) Showing compression arthrodesis of the coxo-femoral joint, (arrow head) showing surgical repair using cross pinning of the distal 1/3rd fracture of the tibia.



Plate 3: Lateral radiograph of a midshaft fracture repair in an 24-month-old Nigerian indigenous bred bitch managed with a single compression bone plate. Note: (A) showing the compression plate used in the management of the condition, (Arrow head) showing the bone lags used and (Arrow) showing the cortico-medullary discontinuity of the tibia

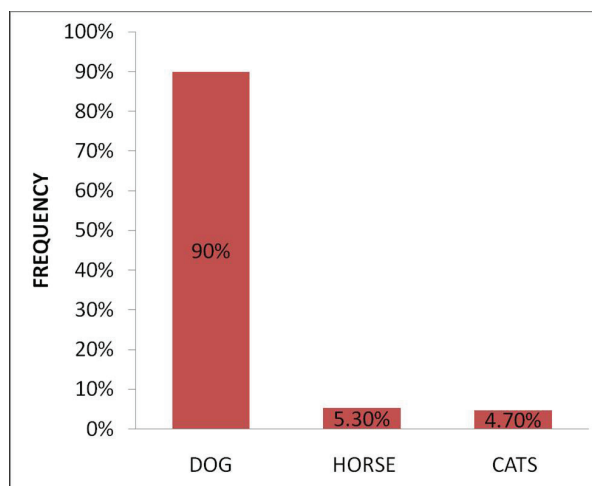


Fig. 1: Prevalence of fractures in dogs cats and horse

law controlling their movement especially in the study area. This attitude exposes the animal to traumatic injuries. Automobile accidents have been identified as the common cause of fracture in Zaria and its environs (Kadima et al., 2008).

- From the study, the femur is by far the bone that is fractured most often in dogs and cats comprising almost half of all long bone fracture in some survey (Piermattei and Flo, 1997, Leonard, 1971, Harassen, 2003).

Recommendation

- Therefore there is a need for legislation to restrict dog movement to reduce the incidence of RTA and the attended high cost of management.

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Improving Working Animal Welfare Through the Development of Wear Resistant Shares and Comfortable Yoke

Emmanuel Y.H. Bobobee

Agricultural Engineering Department

*Kwame Nkrumah University of Science and Technology, Kumasi
Ghana*

Oxen and donkeys are the popular work animals among animal traction farmers in the drier north of Ghana. Uncomfortable yoke, blunt and fast wearing shares are among several constraints faced by animals that compromise their welfare and productivity. The objective of this study is to improve welfare of working animals through the development of abrasive resistant cast steel shares of appropriate sharpness and comfortable yoke. Animal heart rates at rest and work and speed of travel and other behavioural parameters were used to test the endurance of work oxen in farmers environment. Results indicate that wear resistant shares with cutting edge thickness of 2-4 mm produced low heart rates among animals. Also yokes with increased contact areas on the withers led to increased working speed and subsequent higher power outputs of the work animals. These results of low working heart rate and fast working speed confirmed improved welfare status of the animals with the above interventions. The results also present a methodology to evaluate the welfare of working animals using animal heart rate and speed as physiological and behavioural parameters. It is recommended to promote the new technologies among animal traction users to increase the efficiency and productivity of the animals and the farmers for increased food production.

Keywords: working animal welfare, yokes, shares, heart rate, speed

Re-Emergence of Bluetongue Virus Infection in Oyo State, Nigeria

Daniel Oladimeji Oluwayelu¹, Olufemi Olatoye¹, Mark Akanbi¹, Bernd Hoffmann²

*Faculty of Veterinary Medicine
University of Ibadan, Ibadan
Nigeria*

Introduction

Bluetongue (BT) is an infectious, non-contagious, arthropod-borne viral disease of ruminants caused by the BT virus (BTV) which is almost exclusively transmitted by arthropods of the *Culicoides* species and is the prototype species of the genus *Orbivirus*, family *Reoviridae* (Mertens et al., 2005; Tabachnick, 2004). At least 24 serotypes have been identified (Roy, 1992), although a novel BTV thought to likely represent a new serotype has recently been reported (Hoffmann et al., 2008). The clinical signs of BT are usually most severe in domestic sheep and some species of deer, and there can be death of some affected animals (Howerth et al., 1988; Machlachlan, 1994, 2004). Cattle and goats, which usually have subclinical infections, may serve as viral reservoirs for other species (Taylor, 1986). However, some serotypes such as serotype 8, which recently caused infection in Northern Europe, exhibit greater virulence for cattle with marked clinical signs and even mortality (Elbers et al., 2008; Thiry et al., 2006). Economic losses associated with the disease are caused directly through reductions in productivity and death and, more importantly, indirectly through trade losses due to animal movement restrictions, restrictions on the export of cattle semen and the costs of implementing control measures, including diagnostic tests (reviewed by Schwartz-Cornil et al., 2008). BT is widely distributed across the tropical, subtropical and temperate regions of the world.

According to the OIE (2008), the populations of cattle, sheep and goats in Nigeria are 15 million, 51 million and 97 million respectively. Increased production of these animals is however limited by factors such as lack of selection, low genetic potential, low productivity of some indigenous stock, poor nutrition and high incidence of infectious diseases, all of which constitute a great setback to national food security efforts. Some of the infectious diseases that have negatively impacted ruminant production in Nigeria include foot-and-mouth disease, rinderpest, peste des petits ruminants, tuberculosis and bluetongue (Obi, 1997). The first report of BT in Nigeria was by Henderson (1945). Thereafter, moderate to high levels of BTV-specific antibodies have been detected in sheep and goats in Northern Nigeria (Taylor and McCausland, 1976) and Southern Nigeria (Moore and Kemp 1974; Durojaiye, 1979; Obi et al., 1983). Vaccination of domestic and wild ruminants to achieve control of BT is not done in Nigeria neither is there any national surveillance programme in place to monitor the distribution and evolution of BTV. Moreover, considering the genetic heterogeneity of field strains of BTV that occurs as a consequence of both genetic drift and shift, it is possible that the genetic profile of existing Nigerian field BTV strains could have been altered resulting in the emergence of hitherto absent serotypes. The constant trade in sheep, goats and cattle from neighboring West African countries could also result in an influx of BTV from these countries through illegal animal movement or smuggling.

We therefore investigated the presence of BTV antibodies in sheep, goats and cattle in five locations in Oyo state, Nigeria as a first step towards determining the current status of BT in Nigeria through seroprevalence, virus isolation and molecular characterization studies.

Materials and Methods

Sample collection

From October 2009 and February 2010 blood samples from 167 apparently healthy animals comprising 65 sheep, 25 goats and 77 cattle in five different locations in Oyo state, Nigeria were collected. These locations included Bodija cattle market, Eruwa, Igbo-Ora, Ajibode and the University of Ibadan. Oyo State is located in the southwestern part of the country and is

1 Faculty of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria

2 Institute of Diagnostic Virology, Friedrich-Loeffler-Institute, Insel Riems, Germany

characterized by a long rainy season, high humidity and temperature favourable for breeding of the *Culicoides* vector of BT. Several species of *Culicoides* that feed on domestic ruminants have been identified in this area (Dipeolu and Ogunrinade, 1977). Test sera separated after blood clotting were stored at -20°C until tested.

Serology

VP7 is the major BTV immunodominant protein possessing the species or serogroup-specific antigen (Huismans and Van Dijk, 1990) and is widely used for identification of the BT serogroup by serological assays. A commercial bluetongue ELISA kit (IDVET, Montpellier, France) that detects anti-VP7 antibodies in ruminant serum was therefore used to screen the test sera for BTV antibodies. This ELISA has a high sensitivity (~100%) and specificity (> 99.8%) (Toussaint et al., 2007). Briefly, 50 µl control sera (supplied with the kit) and test sera were added to the antigen-coated plate and incubated at room temperature for 45 min ± 4 min. After washing the plate, 100 µl of a VP7 antigen-peroxidase conjugate was added to each well and incubated at room temperature for 30 min ± 3 min. The wells were washed, 100 µl substrate solution was added per well and incubation was done for 15 min ± 2 min at room temperature. The reaction was stopped by adding 100 µl of stop solution and reading was performed using an ELISA reader at 450 nm. Samples presenting a Sample/Positive (S/P) percentage greater than or equal to 30 % were considered positive. A Chi-squared test was used to compare the differences in prevalence of BTV antibodies between locations and between species at 5% level of significance (Thrusfield, 1995).

Results

Of the 167 serum samples screened, 145 (86.8%) were positive for anti-VP7 BTV antibodies. The seroprevalence rates were 89.2% (58/65), 88.0% (22/25) and 84.4% (65/77) for sheep, goats and cattle respectively (Table I). Bodija market was the location in which the highest prevalence was observed, with 100% of the sheep, 81.8% of the goat and 100% of the cattle populations positive for BTV antibodies. There was no significant difference in BTV antibody prevalence rates for sheep and goats between the different locations while a significant difference existed between the locations examined for cattle (Table II). However, no significant difference in prevalence rates was found between the species in the three locations compared (Table III).

Discussion

Previous reports of BTV presence in Nigeria were made about three decades ago (Moore and Kemp, 1974; Milree et al., 1977; Durojaiye, 1979). A study recorded BTV seroprevalence of 28.9% and 29.4% in sheep and goats respectively in Northern Nigeria (Taylor and McCausland, 1976) while a similar study in the South revealed that 58% of sheep and 50% of goat sera had BTV antibodies (Obi et al., 1983). However, although BT is thought to be endemic in Nigeria, there is no information on the current status of BTV infection in Nigerian sheep, goats and cattle since Obi (1985) reported the detection of BTV precipitating antibodies in 68% of goats tested in Oyo, Imo and Anambra states of southern Nigeria. We therefore investigated the prevalence of BTV antibodies in sheep, goats and cattle in Oyo state, Nigeria as a first step towards determining the current status of BT in Nigeria through seroprevalence, virus isolation and molecular characterization studies.

Since vaccination against BT is not practiced in Nigeria, the detection of higher BTV seroprevalence rates of 89.2%, 88.0% and 84.4% in sheep, goats and cattle respectively in this study indicates natural infection with the virus, as well as sustained activity and increased competence of the *Culicoides* vector in transmission of the disease. This is probable because at least 14 BTV serotypes were reported to exist in Nigeria (Herniman et al., 1983) and there is no cross-immunity between the various serotypes. Moreover, since field strains of BTV are known to exhibit genetic heterogeneity, it is possible that the genetic profile of existing Nigerian field BTV strains could have been altered over the past three decades resulting in the emergence of hitherto absent serotypes that could have contributed to the present higher antibody prevalence. This study showed that there was a significant difference in BTV antibody prevalence in cattle between locations examined (Table II). The higher infection rate for Bodija compared to Igbo-Ora could be due to the fact that Bodija market receives cattle from different parts of the country while cattle in Igbo-Ora are mainly resident herds. The convergence of cattle from different parts of the country before they are slaughtered at Bodija market could allow for high detection rate of BTV antibodies. Such convergence could lead to the possible generation of genetic diversity due to reassortment between BTV strains introduced by animals from different parts of the country. However, there was no significant difference in prevalence rate between locations for sheep and goats. This may be due to the management system used for sheep and goats in these locations which

Location	Sheep		Goats		Cattle	
	Positive/ tested	%	Positive/ tested	%	Positive/ tested	%
Ajiboda	13/16	81.3	-	-	-	-
Bodija	4/4	100.0	9/11	81.8	32/32	100.0
Eruwa	21/25	84	-	-	10/10	100.0
Igbo-Ota	-	-	-	-	23/35	65.7
University of Ibadan	20/20	100.0	13/14	92.9	-	-
Total	58/65	89.2	22/25	88.0	45/77	84.4

	Ajiboda	Bodija	Eruwa	Igbo-Ota	University of Ibadan	P-value
Sheep						
No. of samples	16	4	25	--	20	0.19771
% positive	81.3	100	84.0	--	100	
Goats						
No. of samples	--	11	--	--	14	0.5447 (Fisher Exact)
% positive	--	81.8	--	--	92.9	
Cattle						
No. of samples	--	32	10	35	--	0.0002
% positive	--	100	100	65.7	--	

	Sheep	Goats	Cattle	P-value
Bodija				
No. of samples	4	11	32	0.0327
% positive	100	81.8	100	
Eruwa				
No. of samples	25	--	10	0.3029 (Fisher Exact)
% positive	84.0	--	100	
University of Ibadan				
No. of samples	20	14	--	0.4117
% positive	100	92.9	--	

is mainly free-range, backyard system in which few animals are reared per flock unlike in cattle which are raised mainly under semi-intensive system.

In this study, goats and cattle in which BT has been reported to be subclinical (Taylor, 1986), had BTV antibody prevalence rates comparable to that of sheep as no significant difference in BT seroprevalence was found when the infection rates were compared between species at each location (Table III). This suggests the possibility of increased susceptibility of Nigerian goats and cattle to BTV infection. The recent emergence of serotype 8 BTV in Northern Europe, which exhibited greater virulence for cattle with marked clinical signs and mortality indicates the possibility of hitherto resistant species becoming susceptible.

In conclusion, the high prevalence of BTV antibodies in cattle, sheep and goats as demonstrated in this study shows that

BTV infection is widespread in Nigeria and stresses the need for continuous surveillance for BTV antibodies in domestic ruminant populations in Nigeria in order to track the possible evolution of the virus. The fact that cattle from Bodija, Eruwa and Igbo-Ora are brought mainly from the Northern parts of the country either by vehicular transportation or through nomadism suggests that BT may be highly prevalent in the rest of the country. These findings underscore the need for studies to isolate and characterize BTV from Nigerian livestock and *Culicoides* with the aim of identifying currently circulating strains which can be used as vaccine candidates towards achieving effective control of the disease in Nigeria.

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Prevalence of Trypanosome Infection in Trade Cattle at Slaughter in Lafenwa Abattoir, Abeokuta Nigeria

N. Okwelum^a, S.O. Iposu^a, O.S. Sowande^a, O.F. Smith^b, M.I. Takeet^c, E.I. Olugbogi, and S.A. Rahman^d

*Department of Animal Production and Health
College of Animal Science & Livestock Production
University of Agriculture Abeokuta, Ogun State
Nigeria*

Introduction

Trypanosomosis is a serious health problem and a severe constraint to Africa's socio-economic development, which every year claims the lives of over 50,000 people and kills more than 3 million livestock, causing huge economic losses and untold human misery (John, 2004). According to Bourdin (1980) and International Livestock Research Institute (ILRI 1995), attack of farm animals by pest and diseases militate against the expansion of livestock production and could be costly in term of death, reduced performance and curative treatment. It is estimated that agricultural produce worth US\$ 4.75 million is lost each year as a result of trypanosomosis. Hence, continuous surveillance is very necessary to monitor the effectiveness of control measures and also provide epidemiological data for future monitoring and control of the disease. Therefore this study was aimed at evaluating the current status of trypanosome infection in the different breeds of cattle at slaughter in Abeokuta, Nigeria.

Materials and Methods

Sampling area: The sampling was carried out in Lafenwa abattoir in Abeokuta North Local Government, Abeokuta, capital city of Ogun State in South-west Nigeria, situated at 7°9'39" N, 3°20'54"W, in the rainforest vegetation zone of Nigeria (Google Earth, 2006). The processing of blood samples, analysis of haematological parameters, examination and identification of haemoparasites were carried out in the Veterinary Parasitology Laboratory of the College of Veterinary Medicine, University of Agriculture, Abeokuta.

452 cattle (78 Red Bororo, 14 Sokoto Gudali and 360 White Fulani) were sampled. 5ml of blood was collected into EDTA bottle from the jugular vein at slaughter from each animal. Samples were processed and examined for the presence of blood parasites using Thin Blood Smear which was prepared by spreading a single layer of blood on a clean glass slide, fixed in alcohol, stained with GEIMSA also Micro-haematocrit Centrifugation Techniques- Buffy coats were equally prepared same way and examined for haemoparasites under light microscope. The RBC and total white blood cell counts were obtained using Neubauer Chamber. The Haemoglobin concentration was determined colorimetrically using cyanomet-haemoglobin method. Mean Corpuscular Volume and Mean Corpuscular Haemoglobin were calculated from determined PCV, RBC, and Hb concentration, according to Jain (1986). Animals were grouped according to the parasites found and expressed as percentages of the total to show the prevalence rate which was later expressed in a pie-chart. Groups were then subjected to Analysis of Variance (ANOVA) as unbalanced design using the Genstat statistical package. Means that were statistically different were further expressed in bar charts to show the trend graphically.

Results

Figures 1-3.

Discussion

a Department of Animal Production and Health

b Department of Animal Physiology

c Department of Veterinary Parasitology and Microbiology

d Department of Physiology and Pharmacology

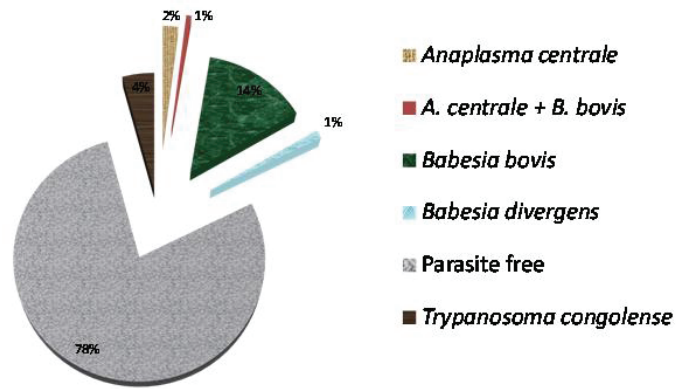


Fig 1: Prevalence of blood parasite species found in trade cattle in Lafenwa abattoir

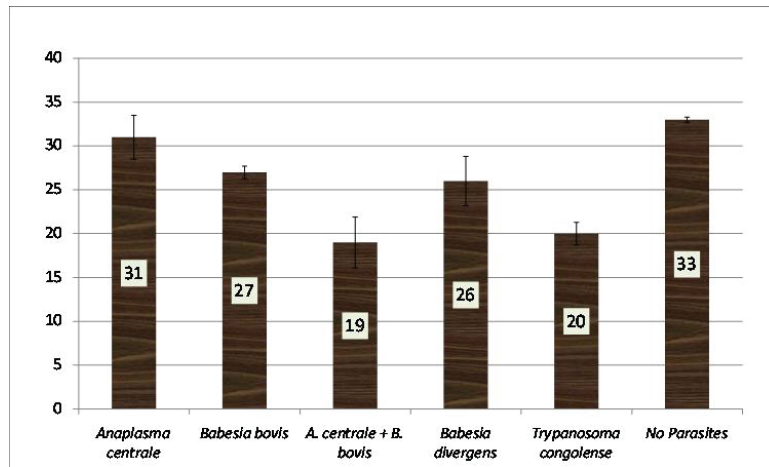


Fig 2: Effect of parasite species on PCV (%) of trade cattle in Lafenwa abattoir

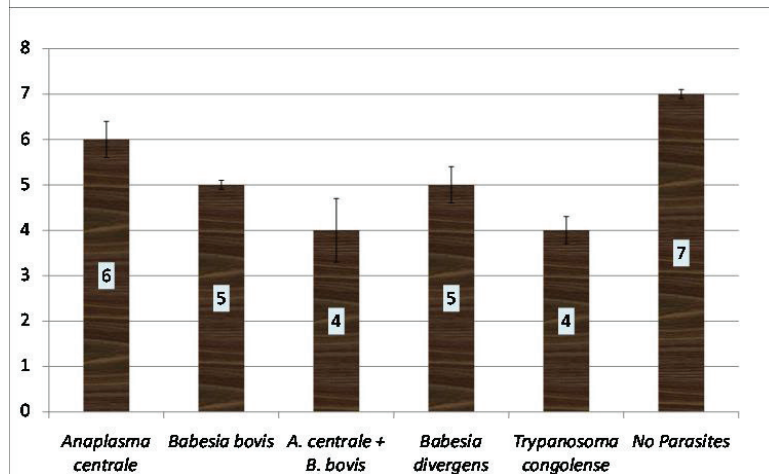


Fig 3: Effect of parasite species on RBC (x 10¹²/L) of trade cattle in Lafenwa abattoir

4% prevalence rate of trypanosome infection in the trade cattle was exclusively due to *Trypanosoma congolense* infection, this species accounted for 100% of the Trypanosome infection cases observed in this study. The significantly lowered PCV, RBC and Hb values of the trypanosome infected cattle and the parasite-free ones is indicative of anaemia and characteristic of *Trypanosoma congolense* infection. Animals infected with *Babesia bovis* were able to maintain a reasonable level of PCV, which appears unusual for animals infected with this species of haemoparasites.

Conclusions

At 4% prevalence rate, trypanosomosis could still be considered to be of epidemiological and economic importance in the study area as infected animals could be source of infection to other herds in the area. Gross alteration of haematological parameters in infected animal is pathophysiologic.

Recommendations

It is recommend that animals should undergo metaphylaxis on arrival from the north and also a more sensitive diagnostic method be used in future study to carry out the disease surveillance.

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Forensic Veterinary Medicine/Pathology in Nigeria

Ighodalo E.T¹, Olabode, H.O.K²

*Central Diagnostic Laboratory
National Veterinary Research Institute Vom Plateau State
Nigeria*

Forensic veterinary medicine/pathology is a rapidly evolving/emerging discipline in the developed country, but here in Nigeria it is a yet to be recognized specialty within the veterinary medical science. The aim is to bring to knowledge the application of forensic veterinary medicine/pathology in animal welfare, abuse and breaches in law.

The paper also hopes to shed more light on what the specialty is all about, information on institutions of learning and recognized association.

Human forensic pathology is of importance and well recognized by the law enforcement agency and it is hoped that forensic veterinary pathology may attain the same height, and hopefully that Nigerian veterinary schools will be ready to join this trendy train.

Keywords: Forensic, Veterinary, Pathology, Nigeria

1 Central Diagnostic Laboratory, National Veterinary Research Institute Vom Plateau State.

2 Faculty of Veterinary Medicine University of Abuja.

Effects of Garlic (*Allium sativum*) on Growth Performance and Vaccinal Immune Response in Commercial Broilers

Oladele Omolade and Bakare Hauwa

*Department of Veterinary Medicine
University of Ibadan, Ibadan
Nigeria*

Introduction

The use of plants and their respective extracts dates back some thousands of years to the ancient Egyptians, Chinese, Indians and Greek (Kamel, 1999). Any plant that can be put to culinary or medicinal use is referred to as medicinal plant (Wainright, 1990). *Allium sativum* commonly known as garlic is a species in the onion family, *Alliaceae*. It is well known as a spice and herbal medicine for prevention and treatment of a variety of diseases (Adimoradi *et al.*, 2006). It has long been considered that garlic has several beneficial effects for humans and animals, exhibiting antimicrobial, anti-oxidant and anti-hypertensive properties (Konjufca *et al.*, 1997; Sivam, 2001). Studies in animals have suggested that allicin, the main biological active component in garlic, has the potential to exhibit anti-tumor activity in mice (Patya *et al.*, 2004). Also, Ghazanfari *et al.* (2002) observed significant increase of delayed type hyper-sensitivity response, but not antibody response to sheep red blood cells in mice. At present, there is increasing pressure to reduce or eliminate the use of antibiotics in poultry feed due to negative human health issues regarding antibiotics resistance. This has resulted in reduction in the use of antimicrobial growth promoters and has caused producers to look for alternative growth promoters to be used in poultry feed (Javandel *et al.*, 2008). The use of non-conventional growth promoters in poultry feed has been found to improve nutrient digestibility, control pathogenic micro-organisms, facilitate favourable intestinal microbial balance and enhance absorption of calorogenic nutrients across the gut wall through increased absorptive capacity (Al-Harathi, 2002; El-Deek *et al.*, 2003). The report of Ghazanfari *et al.*, (2002) that delayed type hypersensitivity response was increased in mice by garlic prompted the assessment of its effects on humoral immune response to vaccinations. Also, it was considered that the numerous beneficial effects of garlic on animals as earlier reported should result in increased productivity at negligible cost. This study was therefore carried out to evaluate the effects of garlic on growth performance and vaccinal immune response of commercial broilers.

Materials and Methods

Experimental Chickens and Maintenance

One hundred day-old broilers of the Arbor acres breed were purchased from a commercial hatchery in Ibadan, Nigeria. They were randomly selected into four separate treatment groups (A, B, C and D) and reared in different cages for 8 weeks. The chicks were fed *ad libitum* with broiler starter ration (from day old to 4 weeks) and broiler finisher ration (from 5 – 8 weeks) supplemented with varying levels of garlic meal. The broilers were administered multivitamins in drinking water from day 1 to 5 and Enrofloxacin[®] prophylactically from day 9 to 13. They were also administered Newcastle disease (ND) vaccine, HB₁ strain on day 1, ND vaccine, LaSota strain on day 21 and infectious bursal disease (IBD) vaccine on days 9 and 18 of age.

Experimental Procedure

The garlic meal used for this study consisted of 70% dried garlic powder and 30% wheat offal as carrier (Javandel *et al.*, 2008). Feed for group A was not supplemented with garlic and served as the control group. Group B had 0.125% garlic meal in feed i.e. 1.25 g/kg feed. Group C had 0.25% garlic meal i.e. 2.5 g/kg feed and Group D had 0.5% garlic meal i.e. 5 g/kg feed. Feed intake per group and body weights of 10 randomly selected birds in each group were measured weekly. Daily body weight gains and feed intake per bird (g/bird/day) of each group were determined and feed conversion ratios (FCR) were thereafter calculated. At 4 and 8 weeks of age, five chickens per group were selected randomly and euthanized. Intestine, liver, spleen, and gizzard were weighed and averages were calculated.

Prior to separation of chicks into groups, 10 chicks were randomly selected and bled for serum to determine ND antibody

levels using haemagglutination inhibition (HI) test as described by Thayer and Beard (1988). Thereafter, the four groups were bled and assessed weekly.

Statistical Analysis

Mean values of weekly body weights and visceral yield as well as weekly MGT values of ND antibody titers of the different groups were compared for statistical significance using the least significance difference method of multiple comparisons.

Results

Average daily feed intake from week 1 to 6 (Table I) was observed to be highest in group D i.e. 104.71 g/bird/day followed by group C i.e. 100.86 g/bird/day while group A had the least value of 99.44 g/bird/day. On the other hand, body weight gain for the same period was highest in group B i.e. 26.49 g/bird/day and least in group A i.e. 23.87 g/bird/day. However, feed conversion ratio was highest in group D i.e. 4.34 and was least in group B i.e. 3.80.

Table I: Feed intake, body weight gain and feed conversion ratio of broiler on garlic meal supplement (1-6 weeks of age)

Group	Feed intake (g/bird/day)	Body weight gain (g/bird/day)	Feed conversion ratio
A	99.44	23.87	4.17
B	100.61	26.49	3.80
C	100.86	24.35	4.14
D	104.71	24.11	4.34

Average weekly body weights of broilers in the different groups are presented in Figure 1. For most of the 8 weeks, group B had the highest average body weight. At 2 week-old, average body weights of groups B and C were significantly higher ($p < 0.05$) than in groups A and D; at 3 week-old, group B had significantly higher ($p < 0.05$) body weight than group D and at 5 week-old, group B had significantly higher body weight than group A. Average body weights in the different groups ended up at a range of 1.85kg in group A to 1.93kg in group B at 8 week-old.

Average visceral weights as percentage of live weights at 4 and 8 weeks old age are presented in Tables II and III respectively. At 4 week-old, intestinal weight was found to be 5.3% in groups A and C and 5% in groups B and D. At 8 weeks of age, intestinal weight was highest in group A i.e. 3.8% and least in group B i.e. 3.2% with the difference between the two values being statistically significant ($p < 0.05$).

Table II: Average visceral yield per weight of broilers on garlic meal supplement at 4 weeks of age (Percentage of live weight)

Group	Intestine (%)	Liver (%)	Gizzard (%)	Spleen (%)	Total (%)
A	5.3	2.5	2.9	0.09	10.8
B	5.0	2.6	2.7	0.1	10.4
C	5.3	2.5	2.7	0.09	10.6
D	5.0	2.4	2.8	0.09	10.3

Table III: Average visceral yield of Broilers on garlic meal supplement at 8 weeks of age (expressed as percentage of live weight)

Group	Intestine (%)	Liver (%)	Gizzard (%)	Spleen (%)	Total (%)
A	3.8	2.3	1.8	0.1	8.0
B	3.2	2.1	2.0	0.1	7.4
C	3.3	2.2	2.1	0.2	7.8
D	3.6	2.2	2.0	0.1	7.9

Average liver weights at 4 weeks of age ranged between 2.4% and 2.6% while at 8 weeks, it ranged between 2.1% and 2.5% in the four groups of broilers. The differences in average liver weights were not statistically significant ($p > 0.05$). At 4

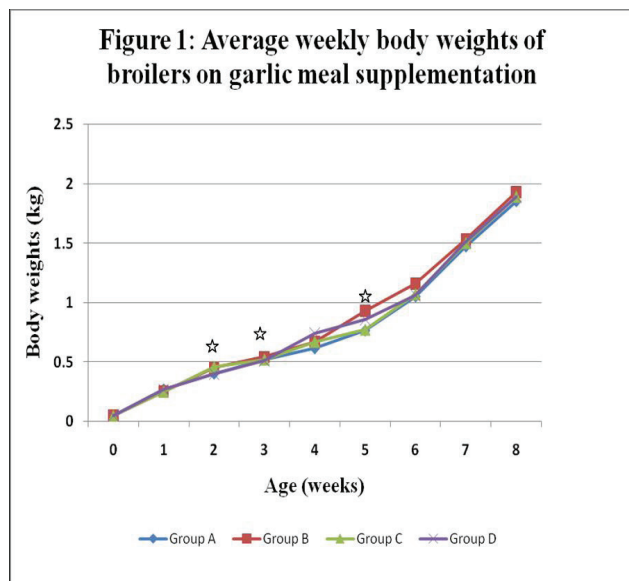


Figure 1: Average weekly body weights of broilers on garlic meal supplementation.

*Statistically significant differences ($p < 0.05$)

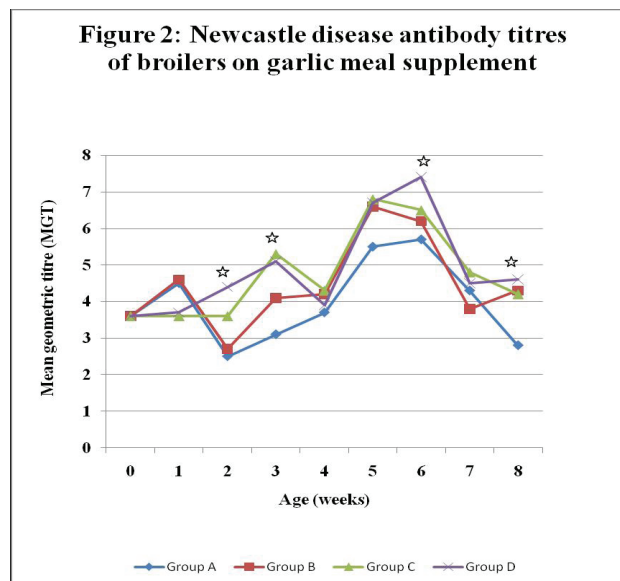


Figure 2: Newcastle disease antibody titres of broilers on garlic meal supplement.

*Statistically significant difference ($p < 0.05$)

weeks of age, gizzard weights ranged between 2.7% and 2.9% and splenic weights ranged between 0.09% and 0.1% while at 8 weeks of age, gizzard weights ranged between 1.8% and 2.1% and splenic weights ranged between 0.1% and 0.2%. With regards to total visceral yield at 8 weeks of age, broilers in group B had the least weight i.e. 7.4% with a resultant highest carcass yield of 1787.2 g/bird (Table IV).

Table IV: Average carcass yield of broilers on garlic meal supplement at 8 weeks of age.

Group	Mean live weight (g)	Visceral yield (%)	Carcass yield (g)
A	1850	8.0	1702.0
B	1930	7.4	1787.2
C	1890	8.1	1734.0
D	1890	7.9	1740.7

Weekly mean geometric titers (MGT) of broilers in the different groups are shown in Figure 2. Generally, group A had consistently lower MGT than groups B, C and D from 2 to 8 weeks old. MGT generally increased from 3.6 at day old to peak levels ranging from 5.7 in group A to 7.4 in group D at 6 week-old, followed by a decline to between 2.8 in group A to 4.6 in group D at 8 weeks of age. Group D had significantly higher titers ($p < 0.05$) than group A at 2, 3, 6 and 8 weeks – old while group C had significantly higher titer ($p < 0.05$) at 3 week – old.

Discussion

Assessment of feed intake and body weight gain showed that while broilers in group B that were fed 0.125% garlic meal had the least feed intake from 1 to 6 weeks of life, it had the highest body weight gain. Feed conversion ratio as well as visceral yield, were also least in group B, the result of which was a higher carcass yield in this group. This shows that broilers in group B were able to utilize the feed consumed more efficiently. Jagdish and Pandey (1994) had earlier observed lower feed conversion ratio in cocks fed diets with 0.25% garlic meal compared to those fed 0.5% garlic meal and the control group. This could imply that the ability of garlic supplementation to improve carcass yield is counterproductive at levels higher than 0.25%. With the lowest carcass yield in group A, the difference between broilers in groups A and B is 85g/bird i.e. 85kg per 1000 broilers raised. At the prevailing cost price of ₦650 (\$4.30) per kg of broiler meat, the increase in revenue for a farmer of 1000 commercial broilers is ₦55,250.00 (i.e. approximately \$363.50). Thus, although the difference in body

weight between control group A and group B at 8 weeks old was not statistically significant ($p>0.05$), it is of economic significance.

Results of HI test for the assessment of antibody response to ND vaccinations showed that broilers in the control group A had consistently lower antibody titers than the groups supplemented with garlic meal with significant differences ($p<0.05$) when compared with groups C and D. However, this is contrary to the finding of Jafari *et al.*, (2008), who reported that the inclusion of garlic powder in the diet of broilers has no beneficial effect on humoral immune response of broilers to live ND vaccines. Earlier workers reported that *Allium* species showed immune enhancing activities that include promotion of lymphocyte synthesis, cytokines release, phagocytosis and natural killer cell activity (Kyo, 1998). Also, GhazanFari *et al.*, (2002) reported increased delayed type hypersensitivity response in mice. These suggest that garlic is an immune stimulant with positive influence on both cellular and humoral immune response. Also, the increased ND vaccinal antibody response observed in supplemented groups appears to be dose dependent with group D having the highest response, although the differences between the groups were not statistically significant ($p>0.05$).

In conclusion, this study has shown that garlic meal supplementation in the diet of commercial broilers at a dose rate of 0.125% reduced feed conversion ratio, increased body weight with economic significance and increased antibody response to Newcastle disease vaccinations. However, the mechanism by which feed conversion ratio is enhanced requires further investigation.

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The Importance of Housing to Increased Small Holder Commercial Poultry Productivity

Akunzule A.N and Kambonga T
P.O.Box, CT5505, Cantonments, Accra
Ghana

1. Introduction

Since 2005, Sankofa Foundation, a diaspora non-governmental organization based in the Netherlands, and its local partners (The Ghana Poultry Network and the Ghana National Association of Farmers and Fishermen) have implemented the Sankofa Family Poultry (SFP) to increase incomes of smallholder poultry farmers. Oxfam Novib is the main sponsor of Sankofa Family Poultry in Ghana. The European Commission-United Nations Joint Migration and Development Initiative supported Sankofa Family Poultry from August 2009 to December 2010.

Sankofa Family Poultry is implemented in Asutsuare, Afiénya, Someh, Dawa, Ada, Tsopoli in the Dangme West and East Districts. In 2009, SFP is also being implemented in Tamale Metro Assembly in the Northern Region.

One of the main techniques used in improving productivity was appropriate construction of poultry housing. Poultry housing was a key component of Sankofa Family Poultry because, SFP wanted to have the most appropriate poultry housing constructed in order to serve as model housing for smallholder poultry producers. This was based on the fact that many different types of poultry houses in the country are very basic, lacking good ventilation and the appropriate holding capacity for birds.

1.1 Objectives of the Sankofa Family Poultry

These include the following:

- To increase biosecurity levels of smallholder commercial poultry farmers from Sector 4 to Sector 2 and 3 by the FAO classification
- To use local materials to improve poultry housing of smallholder commercial poultry farmers
- To train carpenters in appropriate poultry housing using bamboo and neem sticks
- To improve the performance of layer birds to 80% for smallholder commercial poultry
- To improve feed management through appropriate housing
- To improve vaccination coverage with appropriate housing for rural poultry

2. Methodology

The main methods of SFP housing constructed were:

2.1 Bamboo-stick housing method (Figures 1-3)

Figure 1: Type of poultry house construction, with a cement base, raised above the ground, 2005 in Asutsuare

Figure 2: Type of poultry house construction, using neem sticks, thatch, with poles erected high above ground in 2006 in Asutsuare. No need for wood shavings

Figure 3: Roofing Sheet and timber in 2009: Prampram

2.2 Neem tree sticks-housing method (Figure 4)



Figure 1



Figure 2



Figure 3



Figure 4



Figure 5



Figure 6

Figure 4: Neem Stick housing in 2008-Someh

The following method of poultry housing is mainly used in peri-urban and urban centres in the country

2.3 Local timber- housing method (Figure 5)

Figure 5: Local timber housing in peri-urban and urban areas in 2010

However, apart from these methods used by SFP, the following methods are used by rural poultry farmers countrywide. These are mainly in the very remote communities, especially in Northern Ghana.

2.4 Mud housing method (Figure 6)

Figure 6: Poultry house in Donkokrom, 2010

2.5 Millet stalks-housing method (Figure 7)

Figure 7: Millet stalks housing in Navrongo



Figure 7

3. Results

- Two carpenters trained in specific design and construction of smallholder poultry houses
- Litter management and ventilation improved with bamboo and neem sticks poultry housing
- Biosecurity level increased from sector 4 to sector 3 of FAO classification of poultry farms.
- Mortality of birds decreased from 40% to 15%
- Beneficiaries successfully brooded day-old chicks using constructed housing

- Different types of poultry housing constructed with local materials identified countrywide
- Laying performance of layer birds increased from 60% to 80% of lay
- Mortalities due to predators reduced
- Poultry houses is a key element in smallholder poultry keeping, which is often neglected by smallholder poultry producers

4. Discussions

Weather conditions and financial issues in the country especially up north determine the type of housing to be built for rural poultry and small scale commercial poultry farmers. The different types of poultry housing constructed by the Sankofa Family Poultry or identified by field visits were due to the availability of local construction materials in the communities and affordability of beneficiaries to contribute 10% to the cost construction of poultry housing.

In Northern Ghana, climatic conditions are always at the extreme thus making good housing important in both livestock and poultry production. The rains are torrential with rainstorms during the rainy season (May-October) and during the dry season (November-April) temperatures can be as low as below 20 degrees Celsius in the night and as high as above 40 degrees Celsius in the afternoon. The harmattan, which is a dry and dusty wind blowing strongly from the North-East from December to February make conditions very uncomfortable.

The weather therefore is a major determinant of the type of housing to put up for the various ages of birds to offer good protection for optimum productivity. However, due to the fact that housing is a capital investment, makes it expensive, and some farmers often think they can circumvent this expense only to suffer the consequences.

Different types of housing are necessary for the different age groups-chicks, growers, adult-birds. Secondly, there is the need for different types of equipment for the different age groups and products expected. Thirdly, there is also the need for different types of housing to enhance the adoption of recommended management practices.

As part of the discussions, several pictures will be used to explain the different types of housing being used for rural poultry.

4.1 Housing for a clutch of chicks

At this early stage, chicks require warmth, hence in village poultry; they are locked up in the night in a comb-like structure with one entrance which is a round chicken hole. This hole is closed leaving only small spaces for air exchange. Very early in the morning they are released out into the yard for feeding (Figure 8).



Figure 8: Poultry houses with holes as entrances, in the Navrongo Area

4.2 Portable housing to transport chicks to the farm

Sometimes it is necessary to transport chicks to the farm in the morning where they are left on free range to feed while the farmer is doing his farm work. In the evening, the chicks are brought back to the house. Housing and transport brooding (Figure 9)

4.3 Housing for guinea fowl in the night

The natural habitat for guinea fowl in the night is on top of trees. However they are usually

exposed to predators. The recommendation now is to get them night accommodation and then release them in the day into the free range. This means their wing feathers are cut to prevent them from flying on to the trees-tops in the evening. Since they cannot fly, they are forced to enter the pen. After sometime, even when the wings grow they forget that they can fly (Figure 10).



Figure 10: Sticks and wire mesh housing for guinea fowl at night

4.4 Thatch roof

Thatch is recommended for roofing since temperatures in such housing is usually low. This improves the performance of layers and also hatching of eggs in situations where the brood hen is made to sit on eggs in that type of housing (Figure 11).



Figure 11. Mud housing with thatch roof

4.5 Decked roof (Figure 12; 13)

4.6 Record keeping

It is difficult to keep records where birds are not housed. To keep good records birds must be under observation.

4.7 Spent poultry litter for improving soil fertility

The provision of housing enables the use of litter and poultry droppings to be collected. Eventually, when the litter gets old, it is a good source of fertilizing soil to cultivate yellow maize and vegetables for both human and poultry feed.

4.8 Good housing for medication

Before birds are vaccinated, the recommendation is to get them dewormed and provided with antibiotics. However, to the village poultry keeper this is sometimes a problem because of lack of good housing. It is not easy to confine the birds to carry out the above before vaccination. Again it is common to see people chasing birds to catch for vaccination.

4.9 Holes for ventilation

Instead of widows, holes are usually left on the sides of poultry housing to ensure ventilation. They are also small to prevent predators from entering. Also it is not easy for rain to get into the pen through these holes.

4.10 Protection against rain

A mat made from stalks or grass called “zana mats” is hang on the North-Eastern side of the pen to prevent rain and strong winds into the pen (Figure 14).



Figure 12 :Mud Decked housing



Figure 13: Mud-housing with big entrance

4.11 Watering troughs that keep water cool

Watering troughs made with clay keep water cool during hot weather, from March-April. Also they are placed in some cage made with stalks such that

only birds have access to the water but not animals which will drink all the water or pour it out.

5. Conclusions

- Different types of poultry housing are necessary for the different age groups-chicks, growers, and adult-birds.
- Management in terms of feed waste is reduced by 80% with appropriate housing for smallholder commercial poultry and rural poultry.
- Rural poultry still stay on top of trees even though veterinary extension has been used for the last four decades.
- Housing makes it easy for cleaning and disinfection which will increase biosecurity to very high level in small holder commercial poultry and rural poultry farmers.
- Poultry housing will increase mass vaccination coverage of up to 85% against Newcastle Disease, using thermostable I-2 vaccine for poultry



Figure 14: Stalk-housing

6. Recommendations

- Non-governmental organizations need to reach out to farmers to improve housing for rural poultry.
- Extension messages on appropriate housing for smallholder commercial poultry and rural poultry to be broadcast on local radio FM stations.

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Consecutive Analysis of Avian Influenza (AI) Active Surveillance Samples by Virus Isolation and End-Point RT-PCR for Increased Sensitivity and Specificity

Awuni J.A, Oddoye J.J, Sedor V.B

*Accra Veterinary Laboratory
Veterinary Services Directorate, Accra
Ghana*

Highly Pathogenic Avian Influenza (HPAI/H5N1) was first detection in Ghana in April 2007 in a commercial poultry farm in the Greater Accra Region. By June the same year seven outbreaks were confirmed in the country. After the successful containment of the outbreaks in the country, a number of active surveillance activities have been carried out to determine if the virus was still circulating in domestic poultry and wild bird populations in the country. Since June 2007, 5,011 tracheal and/or cloacal swabs were collected from domestic poultry and wild birds all over the country. All the samples were tested consecutively by virus isolation in embryonated chicken eggs and after two passages then by gel detection RT-PCR using primer sets targeting the Matrix gene. The two tests which are conditionally independent, thereby significantly increased the specificity of testing up to 99.95% and the negative predictive value up to 99.6%. Reported here are the results of these consecutive testing, which clearly indicate that the country is free from the infection.

The Effect of Basic Laboratory Detergents on the Infectivity of HPAI/H5N1 Virus

Awuni J.A, Oddoye J.J, Sedor V.B

*Accra Veterinary Laboratory
Veterinary Services Directorate, Accra
Ghana*

With regard to Highly Pathogenic Avian Influenza due the H5N1 subtype of the influenza type A viruses (HPAI/H5N1) biosafety is of paramount importance. Hence, the handling of live viruses is commended only for laboratory of the BSL 3 categories. However, for rapid and accurate diagnosis of the disease, to ensure the early implementation of effective control measures, satellite laboratories must be capable of working with the viruses. Haemagglutination Inhibition (HI) test can be carried out in many regional laboratories in Developing countries with minimal cost.

In this work, we investigated the ability of different concentrations of some basic laboratory detergents such as SDS and Tween-20 to completely inactivate the Highly Pathogenic Avian Influenza virus H5N1 while maintaining its haemagglutinating activity.

The H5N1 viruses were found to be completely inactivated by 1.0% (v/v) of SDS after 60 minutes incubation at room temperature. Tracheal swabs containing the viruses treated this way were then very safe for handling in BSL1 & 2 laboratories (Satellite Laboratories). This ensured the rapid detection of H5 subtypes in domestic poultry.

Introduction

Influenza viruses are enveloped negative-strand RNA viruses belonging to the family of *Orthomyxoviridae*. Viruses of the *Influenzavirus A* genus cause avian influenza (AI) when infecting birds (1, 2). The surface of the virion is covered with closely spaced spikes or projections 10-20nm in length. These spikes are of distinct shapes and are the Haemagglutinin (HA) and the Neuraminidase (NA). Type A influenza viruses are further divided into subtypes based on these spikes. At present 16 HA subtypes have been recognized (H1–H16) and nine NA subtypes (N1–N9). Each virus has one HA and one NA antigen, apparently in any combination. All influenza A subtypes in the majority of possible combinations have been isolated from avian species (3).

To date only viruses of H5 and H7 subtype have been shown to cause Highly Pathogenic Avian Influenza (HPAI) in susceptible avian species, but not all H5 and H7 viruses are virulent (4). The highly pathogenic subtype H5 and H7 viruses have caused several outbreaks with devastating economic consequences. Viruses belonging to the H9 subtype are LPAI viruses, but in the last decade, several outbreaks caused by the H9N2 virus have occurred across a wide geographical area, causing serious disease problems in commercial poultry in Iran, Pakistan, and the Middle East (5, 6, and 7).

The significant problems caused for the poultry industry by subtype H5, H7, and H9 viruses and the increased risk of direct transmission of these viruses to humans highlight the need for a highly sensitive, accurate, and rapid test to reveal, as early as possible, the circulation of these viral subtypes in the susceptible avian population. Since late 2003, highly pathogenic avian influenza (HPAI) outbreaks caused by infection with H5N1 virus has led to the deaths of millions of poultry and more than 10 thousands of wild birds, and as of 18-March 2008, at least 373 laboratory-confirmed human infections with 236 fatalities, have occurred (9). The worldwide spread of the disease is providing more opportunities for viral re-assortment within a host (genetic shift) and mutation over time (genetic drift). These factors may lead to a viral strain that is more efficient at person-to-person transmission, raising the potential for another pandemic to occur (10).

Newcastle disease is endemic in Ghana being responsible for the annual lost of over 80% the population of village chicken. The clinical and pathological lesions of ND are indistinguishable from those of HPAI, therefore the outbreak of ND greatly hinder the detection of HPAI. There also exists the possibility of co-infection of both viruses further compounding the early and rapid detection of HPAI/H5N1 with its associated consequence of Human infection / Pandemic Influenza.

The suitability of Haemagglutination Inhibition Test (HI) as described here to rapidly detect H5, H7 and H9 subtypes

of the Influenza A viruses and simultaneously differentiate them from ND is immense. However, the bio-hazard associated with the handling of these viruses limits its application to laboratories with high levels of Biosafety. Satellite laboratories (biosafety Level 1 Type laboratories), which are usually closed to foci of outbreaks, can significantly contribute to the early detection of HPAI, if samples are treated in such a way as to make them safe to handle under their conditions.

The influenza virus particles can be disrupted by detergents resulting in the release of the HA and NA projection which retain their respective activities. The HA and NA, in addition to a small protein called M2, are embedded in lipid envelope derived from the plasma membrane of the host cell. The lipids located in the viral membrane are mostly phospholipids with smaller amounts of cholesterol and glycolipids. This makes the viruses very sensitive to inactivation by lipid solvents, such as detergents. Infectivity is also rapidly destroyed by formalin, α -propiolactone, oxidizing agents, dilute acids, ether, sodium desoxycholate, hydroxylamine, sodium decylsulfate and ammonium ions (3).

Influenza and Newcastle disease viruses are pneumo-enteric, being released in respiratory secretions and faecal droppings of infected birds. Therefore tracheal and cloacal swabs well taken from moribund or recently dead birds will contain significant quantity of virus detectable by HA/HI.

Scientific evidence collected in recent years, lead to the logical conclusion that not only HPAI must be controlled in domestic poultry population but also Low Pathogenic Avian Influenza (LPAI) due viruses of the H5 and H7 subtypes, as they represent HPAI precursors. For this reason, both HPAI and LPAI belonging to H5 and H7 subtypes are considered by the OIE as notifiable diseases. The early and rapid detection of these viruses in domestic poultry populations is therefore very crucial in the prevention of HPAI.

Materials

- Class II microbiological Safety Cabinet, Model Envair BIO 2+, from Envair Ltd, Lancashire, England.
- Personal Protection equipment (PPEs)
- Sodium Dodecyl Sulphate (SDS) EC Lot 9107S
- Tween 20
- Dulbecco's Phosphate Buffered Saline (D5773-10x1L)
- Alsever's solution from erredue s.p.a
- 14mls graduated centrifuge tubes
- Measuring cylinder (ranges 250mls, 50mls)
- V-bottomed microtitre plates
- Microtitre pipettes (multi and single channels ranges, 5-50 μ l and 20-200 μ l)
- Microtitre pipettes tips (yellow and blue)
- Dispensing troughs
- Chicken for RBCs
- Non powdered Disposable gloves
- Egg incubator
- Egg Candler
- Egg shell puncher
- 1ml disposable syringes with needles
- Candle wax
- Bunsen burner with Liquefied Petroleum gas
- Tripod
- Pasteur pipettes

- Embryonated chicken eggs from Specific Antibody Negative (SAN) for AI viruses
- Positive Serum of H9N2 for Haemagglutination Inhibition (batch 3.06 expiry 03/2011)
- Negative Serum (Batch 2.05, expiry 02/2010)
- Inactivated antigen H9N2 for HI (Batch 02/04, expiry 02/2009)
- Inactivated Antigen H7N1 (Batch 05/04, expiry 11/2009)
- Standard Positive Serum of the subtype H7N1 for HI (Batch 5/99, expiry 09/2009)
- Inactivated Antigen H5N3
- Standard Positive Serum of the H5N3 subtype of the Influenza A
- Newcastle disease (PMV1) Standard Positive serum
- Thermostable Newcastle disease (NDI-2) vaccine virus

All the Inactivated influenza viral antigens and their corresponding positive sera, the negative serum as well as the PMV1 antigen and positive serum were supplied by the OIE reference Laboratory for AI and ND, Istituto Zoo profilattico delle Venezie, Padova, Italy.

Procedure

One litre of Transport medium for the Avian Influenza (AI) samples collection and preservation was prepared with the following concentrations of the corresponding antibiotics and mycostatin in Phosphate Buffered Saline (PBS, pH 7.0 – 7.4); 10,000IU/ml BenzylPenicillin, 10mg/ml Streptomycin sulfate, 0.25mg/ml Gentamycin sulfate and 5,000 IU/ml Mycostatin (11). This is allowed to stay overnight at room temperature and enhance the activity of the antibiotics. Samples of this is then plated on solid bacteriological media (Sheep blood agar) and incubated at 37°C for three days to rule out any possible bacterial contaminants.

Two fold serial dilutions of Tween -20 (10.0%, 5.0%, 2.5% and 1.25%) and Sodium Decyl Sulfate (2.0%, 1.0% and 0.5%) in PBS with antibiotics and mycostatin, a usual viral transport medium for field samples, were tested for their effect on chicken RBCs. This was done by dispensing 25µl of PBS into all wells of the 96-well V-bottomed microtitre plate, then 10.0% Tween-20 into all wells of rows A & B, 5.0% Tween-20 into wells of rows C & D, 2.5% Tween-20 into wells of rows E & F, and 1.25% Tween-20 into wells of rows G & H. Wells of column 11 and 12 contained 50µl of PBS to serve as RBC controls. This was repeated similarly in a second plate with 2.0%, 1.0% and 0.5% of SDS. Then immediately 25µl of 1% freshly prepared chicken RBCs was added to all the wells of the plate in ascending order of the Tween-20 and SDS dilutions making sure the tips do not touch the contents of the wells. The plate is tapped gently to mix the contents and allowed to stand at room temperature. The results are read in 45 minutes, comparing the size of the settled RBCs in the tests wells to those in wells of columns 11 & 12.

In the second step of the trial, two-fold serial dilution was made of allantoic fluid containing the H5N1 virus strain isolated from the first outbreak in Ghana in April 2007. This had a virus concentration of 2⁸ HA titre so after the two-fold dilution a final concentration of 2⁷ HA titre (dose sufficient to infect the chicken embryo) was made in each of the 1.0 % and 0.5% of SDS, as well as 1.25% and 2.50% of Tween-20 in PBS with antibiotics and mycostatin. The contents are gently mixed and incubated at room temperature for 15, 30 and 60 minutes. At the end of each of this incubation times, the samples were gently mixed to ensure homogeneity and 0.2ml of the various dilutions with the H5N1 virus were inoculated into allantoic cavity of each of five, 10-days old embryonated chicken eggs. The inoculated site was sealed with pre melted candle wax and the eggs well labeled according to the sample used. Similarly, the neat 2.5%, 1.25% dilutions of the Tween-20, 1.0% of SDS, the viral transport medium, the H5N1 virus suspension, NDI-2 vaccine virus were separately inoculated into five eggs as controls. Five eggs not inoculated were also incubated to control the incubation temperature. The eggs are then incubated at 37°C and candled daily for a total incubation period of 4- days. During the daily candling, any eggs with dead embryos are removed and chilled overnight and tested for the presence of any Haemagglutination activity. At the end of the four-day incubation period, all the eggs were chilled over night.

After chilling over night, the eggs were transferred onto plastic egg trays, wiped with 70% ethanol and opened in a

Biosafety Class II cabinet with full protective equipment worn by staff. 40ul of allantoic fluid from each egg was added to an equal volume of freshly prepared 10% chicken Red Blood Cells (RBCs) onto an agglutinating plate and gently mixed while observing for agglutination; a rapid Haemagglutination (HA) test (12). Samples showing agglutinating activity were tested in a microtitre quantitative HA test (12) to determine the amount of virus in the allantoic fluid (HA units) and a dilution of it made to contain 4HA units. The agglutinating virus was then identified in a Haemagglutination Inhibition (HI) test. Samples without activity are noted as negative since it initially contained infective dose of virus.

Haemagglutination Inhibition test for antigen detection.

Using a single channel microtitre pipette, 25ul of Standard Specific serum against the H5N3 subtype of the Influenza A virus was dispensed in all wells of Rows A & B of a V-bottomed microtitre plate except column 12. Similarly sera of Subtypes H7N1 into wells of Row C & D, H9N2 wells of Rows E & F, NDV into wells of Row G and Negative Serum into wells of Row H. 25ul of the dilutions containing 4HA units of the agglutinating agents was dispensed into all wells of the columns, with each sample in each column going through all the standard sera. The Standard Specific inactivated antigens of the subtype H5N3, H7N1, H9N2, NDV and PBS used as controls. Wells of column 12 contain only PBS as control of the RBC. The contents were tabbed gently to mix and allowed to incubate at room temperature for 20 minutes for antigen-antibody reaction. After this incubation period, 25ul of freshly prepared 1% chicken RBC was added to all wells of the V-bottomed microtitre plates, gently mixed and incubated at ambient temperature for 45 minutes and observed for any inhibition of haemagglutination, bottoming of RBCs.

Results

All the embryos inoculated with the Detergent only as well as the detergent with virus died within 48- hours post inoculation (Table 1 & 2).

Haemagglutinating activity was detected in all the embryos inoculated with H5N1 in 2.50%, and 1.25% Tween-20 even after 60- minute's treatment. However, with the 1.0% SDS haemagglutins were detected in only two embryos when the virus was treated with the detergent for 30 minutes, but after 60 minutes there was none. With the 0.5% SDS it was only after the virus was treated for one hour that no haemagglutins were detected in only three (3) of the Five (5) embryos inoculated (Table 3 & 4).

Discussion

It was noted that 10%, 5.0%, 2.5% Tween-20 as well as 2.0%, 1.0% SDS coagulated the 1.0% freshly prepared chicken Red Blood Cells (RBCs) preventing "tear formation" an indication of proper settling.

The various dilutions of the detergents alone adversely affected the chicken embryos resulting in their death within 48-hours post inoculation. However, where virus was present, the time lapse before the death of the embryos was sufficient enough to allow significant viral growth. The presence of these viruses could be detected by Haemagglutination test.

The I-2 strain of the Newcastle disease is avirulent and hence does not kill chicken embryos. The non inoculated embryos remained alive throughout the 48-hours of incubation signifying that there had not been any adverse changes in the incubation conditions. Those inoculated with the PBS with antibiotics only also did not die further confirming that any embryo death could be due to viral growth or the effects of the detergents.

Therefore the detection of virus in only Two of out the Five embryos inoculated with the H5N1 virus treated with 1.0% SDS for 30 minutes at room temperature, as well as the no detection of virus at all after 60 minutes incubation represents 60% and 100% inactivation of the virus respectively. The 0.5% SDS inactivated 60% of the H5N1 virus only after incubation at room temperature for one hour. The 2.5% and 1.25% Tween-20 did not inactivate the virus during the whole period of the treatment.

Conclusion

The Highly Pathogenic Avian Influenza virus H5N1 was completely inactivated after treating it with 1.0% SDS for

Table 1. Eggs Inoculation

No.	Sample	Dilution of detergent	Number of eggs inoculated		
			15 minutes	30 minutes	60minutes
1	H5N1	2.5% Tween-20	5	5	5
2	“	1.25% tween-20	5	5	5
3	“	1.0% SDS	5	5	5
4	“	0.5% SDS	5	5	5
5	H5N1 Only (PSG)				5
6	NDI-2 Only (PSG)			5	
7	1.25% Tween-20 only				5
8	2.50% Tween-20 only				5
9	1.0% SDS only				5
10	0.5% SDS only				5
11	PBS with antibiotics only				5
12	Non Inoculated eggs				5
Total Number of eggs needed			20	20	65

Table 2. Results after 96- hours of incubation

No.	Sample	Dilution of detergent	Number of eggs inoculated		
			15 minutes	30 minutes	60minutes
1	H5N1	2.5% Tween-20	5/5	5/5	5/5
2	“	1.25% tween-20	5/5	5/5	5/5
3	“	1.0% SDS	5/5	5/5	5/5
4	“	0.5% SDS	5/5	5/5	5/5
5	H5N1 Only (PSG)				5/5
6	NDI-2 Only (PSG)			0/5	
7	1.25% Tween-20 only				5/5
8	2.50% Tween-20 only				5/5
9	1.0% SDS only				5/5
10	0.5% SDS only				5/5
11	PBS with antibiotics only				0/5
12	Non Inoculated eggs				0/5

one hour under room temperature. Its haemagglutinating activity still remained and the presence of disintegrated virus particles can be detected by Haemagglutination (HA) test.

District veterinary laboratories or satellite laboratories which are usual BSL 1 type, using this approach to inactivate the virus can handle HPAI viruses with minimal risk to human health. This will go a long way to improve upon the early and rapid detection of any outbreaks of HPAI and ensure the immediate implementation of containment measures, while samples are dispatched to National and References AI diagnostic laboratories for confirmation.

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Table 3. Detection of Haemagglutination Activity

No.	Sample	Dilution of detergent	Number of eggs inoculated		
			15 minutes	30 minutes	60minutes
1	H5N1	2.5% Tween-20	5/5	5/5	5/5
2	“	1.25% Tween-20	5/5	5/5	5/5
3	“	1.0% SDS	5/5	2/5	0/5
4	“	0.5% SDS	5/5	5/5	2/5
5	H5N1 Only (PSG)				5/5
6	NDI-2 Only (PSG)			5/5	
7	1.25% Tween-20 only				0/5
8	2.50% Tween-20 only				0/5
9	1.0% SDS only				0/5
10	0.5% SDS only				0/5
11	PBS with antibiotics only				0/5
12	Non Inoculated eggs				0/5

Table 4. Detection of Specific Viral agents

No.	Sample	Dilution of detergent	Number of eggs inoculated		
			15 minutes	30 minutes	60minutes
1	H5N1	2.50% Tween-20	H5N1 virus	H5N1 virus	H5N1 virus
2	“	1.25% Tween-20	H5N1 virus	H5N1 virus	H5N1 virus
3	“	1.0% SDS	H5N1 virus	H5N1 virus (2/5)	No Virus detected
4	“	0.5% SDS	H5N1 virus	H5N1 virus	H5N1 virus(2/5)
5	H5N1 Only (PSG)		H5N1 virus		
6	NDI-2 Only (PSG)		NDI-2 virus		
7	1.25% Tween-20 only		No Virus detected		
8	2.50% Tween-20 only		No Virus detected		
9	1.0% SDS only		No Virus detected		
10	0.5% SDS only		No Virus detected		
11	PBS with antibiotics only		No Virus detected		
12	Non Inoculated eggs		No Virus detected		

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ProMED-Mail and HealthMap: Information Communication Technology Partnership for Improved Emerging Animal Disease Reporting for English-Speaking Africa

Babalobi O.O

*Department of Veterinary Public Health and Preventive Medicine
Faculty of Veterinary Medicine, University of Ibadan, Ibadan
Nigeria*

Under-reporting of emerging (animal) disease outbreaks is a common feature reported in many developing countries using the official International office for Epizootics (OIE) disease reporting format. This had led to calls for use of alternative unofficial disease notification and reporting sources to augment and improve the existing official disease reporting system. The development and use of Information Communication Technology ICT and its application to Veterinary medicine has provided opportunities for development of more reliable, effective and efficient emerging disease reporting, monitoring, surveillance, prevention and control. Two of such developed opportunities are the Programme for Emerging Diseases (ProMED) - mail (<http://promedmail.org>) and the HealthMap (www.healthmap.org).

ProMED-mail is an internet-based reporting system dedicated to rapid global dissemination of information on outbreaks of infectious diseases and acute exposures to toxins that affect human health, including those in animals and in plants grown for food or animal feed. Electronic communications enable ProMED-mail to provide up-to-date and reliable news about threats to human, animal, and food plant health around the world, seven days a week. ProMED-mail is a program of the International Society for Infectious Diseases and currently reaches 53,000 subscribers in more than 185 countries.

HealthMap brings together disparate data sources to achieve a unified and comprehensive view of the current global state of infectious diseases and their effect on human and animal health. This freely available Web site integrates outbreak data of varying reliability, ranging from news sources (such as Google News) to curated personal accounts (such as ProMED) to validated official alerts (such as World Health Organization). Through an automated text processing system, the data is aggregated by disease and displayed by location for user-friendly access to the original alert.

ProMED-EAFR (<http://eaf.promedmail.org/>), is a sub-regional initiative focusing on emerging diseases in English-Speaking Africa that was developed collaboratively by ProMED-mail and HealthMap. The objective of this initiative is to increase access to information on the part of health care professionals from both the human and animal health sectors throughout English-speaking Africa. Subscription to ProMED-EAFR is free of charge on <http://www.isid.org/promedmail/subscribe.lasso> or through ProMED-EAFR - Subscription <http://promedmail.chip.org/mailman/listinfo/promed-eafr>

The development, use and application to Veterinary Medicine of Information Communication Technology ICT and Internet Web Communication Technology WCT has provided opportunities for development of more reliable, effective and efficient emerging disease reporting, monitoring, surveillance, prevention and control (Cowen *et al* 2004, Madoff L. C. and Woodall J. P, 2005, Jebra and Shimshony, 2006 and Babalobi O. O. (2010). Two of such developed opportunities are the Programme for Emerging Diseases (ProMED) - mail (<http://promedmail.org>) and the HealthMap (www.healthmap.org).

ProMED-mail is an internet-based reporting system dedicated to the early detection and rapid global dissemination of information on outbreaks of infectious diseases and acute exposures to toxins around the world that affect human health, including those in animals and in plants grown for food or animal feed. ProMED reports on both plants and livestock animal diseases, human diseases, zoonotic diseases and diseases that affect sources of human nutrition. Electronic communications enable **ProMED-mail** to provide up-to-date and reliable news about threats to human, animal, and food plant health around the world, seven days a week. ProMED-mail currently reaches 53,000 subscribers in more than 185 countries and is a program of the International Society for Infectious Diseases ISID (www.isid.org).

HealthMap - Global Health, Local Information (<http://healthmap.org/en/>)

a Global disease alert mapping system, brings together disparate data sources to achieve a unified and comprehensive

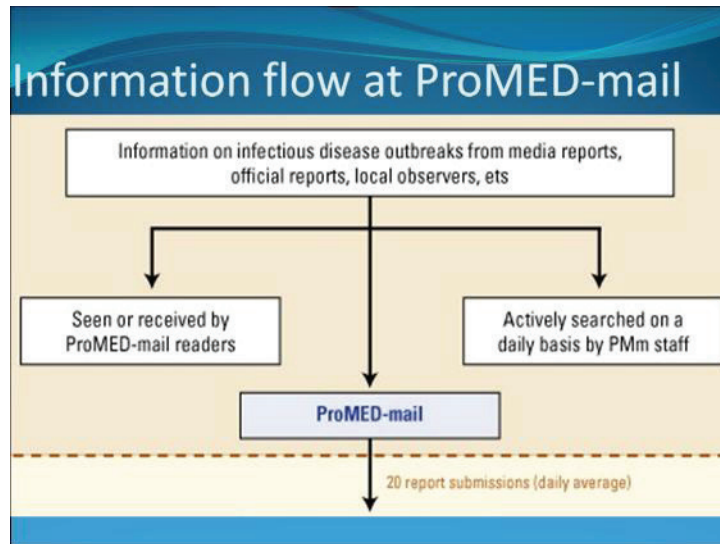


Figure 1: Information flow at ProMED-mail

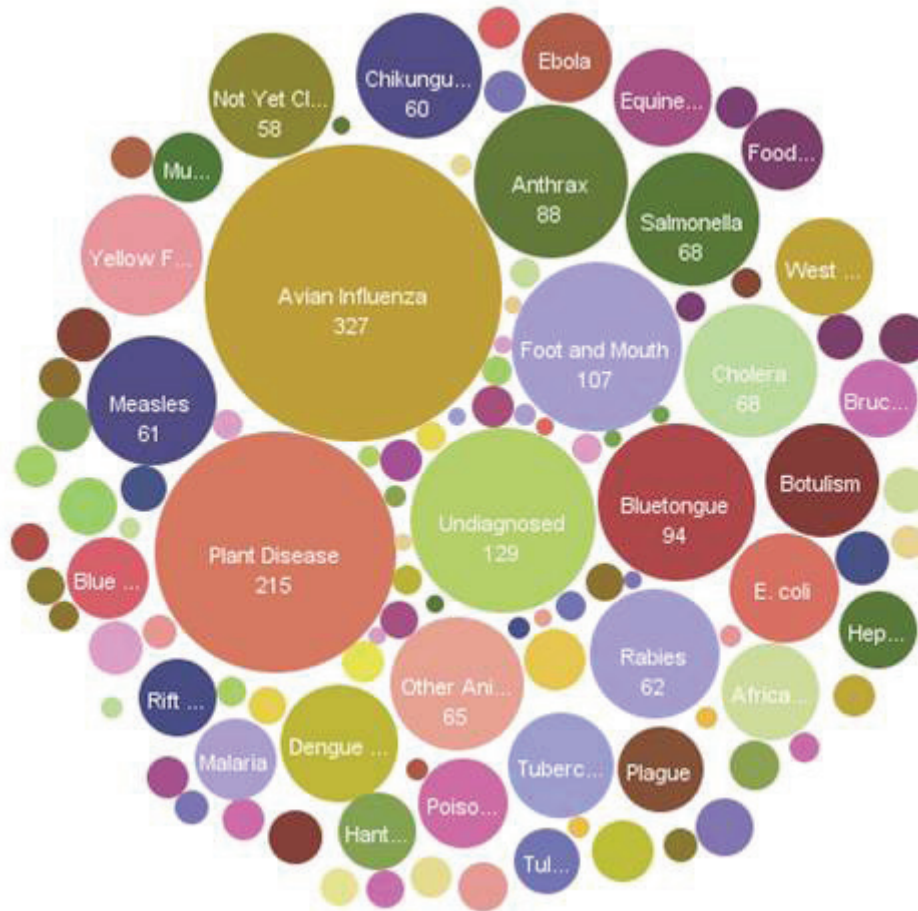


Figure 2: ProMED Report Year Summary: Disease Representation 06/2007-06/2008

view of the current global state of infectious diseases and their effect on human and animal health. This freely available Web site integrates outbreak data of varying reliability, ranging from news sources (such as Google News, Moreover and Wildlife Disease Information Node) to curated personal accounts (such as ProMED) to validated official alerts (such as World Health Organization and Eurosurveillance).

Through an automated text processing system, the data is aggregated by disease and displayed by location for user-friendly access to the original alert. HealthMap provides a jumping-off point for real-time information on emerging infectious diseases and has particular interest for public health officials and international travellers. Healthmap searches 20,000 websites every hour, tracking about 75 infectious diseases, including malaria, cholera, Ebola, and recently also swine flu. An average of 300 reports are collected each day, about 90% of which come from news media sources. HealthMap is a Google project, with map and satellite options, and has blog, facebook and twitter versions.

ProMED-EAFR alerts on HealthMap (<http://healthmap.org/promed>)

a website dedicated to the display of location reported by ProMED-mail, and is a classical example of partnership in the application of Information Communication Technology ICT and Internet Web Communication Technology WCT to improved emerging disease reporting ProMED-EAFR covering Anglophone English-Speaking Africa

ProMED-EAFR: Anglophone Africa

ProMED-EAFR (<http://eafr.promedmail.org/>), is a sub-regional initiative focusing on emerging diseases in English-Speaking Africa that was developed collaboratively by ProMED-mail and HealthMap. The objective of this initiative is to increase access to information on the part of health care professionals from both the human and animal health sectors throughout English-speaking Africa. “;

Subscription to ProMED-mail or any of the regional ProMED is free of charge on <http://www.isid.org/promedmail/subscribe.lasso>

Subscription to ProMED-EAFR can be done via <http://promedmail.chip.org/mailman/listinfo/promed-eafr>

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Evaluation of the Effectiveness of Animal Diseases Reporting System in Oyo State, Nigeria (1995-2005): The Relevance of ProMED-Mail

Bolajoko, M.B¹ and Babalobi, O.O²

*Department of Veterinary Public Health and Preventive Medicine
Faculty of Veterinary Medicine, University of Ibadan, Ibadan
Nigeria*

Introduction

Animal Disease Reporting System ADRS entails the provision of needed and timely information on morbidity and mortality to permit the institution of appropriate control and prevention measures as well as encouraging uniformity in data reported so that comparison of data within country and between nations can be made (Nigeria 1982, Kouba 2003,). Poor-reporting and under-reporting of animal disease outbreak is a common feature in most developing countries (including Nigeria), who are poorly using the official disease reporting system of the International Office for Epizootics OIE/WAHO (Ogundipe 1984, Ogundipe *et al* 1989). This has made the additional use of informal reporting system such as Program for Emerging Diseases (ProMED)-mail needful and relevant to such countries (Ben Jebra and Shimshony 2006).

Materials and Methods

Retrospective study and open-ended interview was utilized to evaluate the effectiveness of the operational system of the Animal Disease Reporting System ADRS, now known as National Animal Disease Information System (NADIS) of Oyo State, Nigeria, one of the 36 States in Nigeria, on six animal disease of the list "A" Notifiable diseases: African swine fever (ASF), Foot and mouth disease (FMD), Contagious bovine Pleuro pneumonia (CBPP), Avian influenza (AI), Rinderpest and Peste des Petite Ruminants (PPR); by examining the following criteria for the period 1995 to 2005:

Accuracy of data received by examining the records for dual notifications and adequacy of the diagnostic method used for each case;

1. Notification Efficiency NE (completeness) – the ratio of the number of cases reported to the total actual infection of clinical cases

$$\text{Notification Efficiency (NE \%)} = \frac{\text{Number of cases reported}}{\text{Total number of actual clinical infections}} \times 100$$

Measured at the three stages of reporting:-

- a. Primary stage: reports from the farmers to the veterinarians;
 - b. Secondary: reports from the veterinarians to the State monitoring officers;
 - c. Tertiary: reports from the State monitoring officers to National Animal Disease Information Systems NADIS offices. and
2. Speed of data reported – Open-ended interview was utilized when necessary to get a clearer picture of the past and present status of the system's operations. Respondents included veterinarians, animal health staff, laboratory scientist and auxiliary staff in the State and federal. Checklist were used for the open-ended interview

Results

1 National Veterinary Research Institute, Vom, Plateau State-Nigeria

2 Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria

For the 10 year period,

- one case each of CBPP and FMD were reported in 1995,
- there were no reported outbreak between 1996-2000, 2002 and 2003,
- eleven cases of ASF outbreak were reported in 2001,
- one case of FMD in 2004 and
- Two cases of FMD in 2005.

Table 1: Reported outbreaks of the six notifiable animal diseases in Oyo State Nigeria 1995-2005

Year	Disease	Date of Occurrence	Date Reported	Location	Morbidity	Mortality
1995	CBPP	----	26/9/1995	----	----	----
	FMD	----	6/9/1995	----	----	----
1996 to 2000	----	----	----	----	----	----
2001	ASF	15/5/2001	17/9/2001	----	----	----
	ASF	----	27/8/2001	----	----	----
	ASF	----	29/8/2001	----	----	----
	ASF	16/8/2001	27/8/2001	----	----	----
	ASF	19/10/2001	28/10/2001	----	----	689 from
	ASF	30/10/2001	23/11/2001	----	----	100 pigs
2002	----	----	----	----	----	----
2003	----	----	----	----	----	----
2004	FMD	16/8/2004	24/8/2004	----	----	3
2005	FMD (2 Cases)	10/8/2010	6/9/2005	----	----	----

Discussion

Accuracy of data: *(Trace-back investigation revealed that the two FMD cases reported in 2005 was a case of dual notification of the same outbreak). Only 18.2% of all reported cases were confirmed.

Notification efficiency: could not be determined at the primary stage (First Tier) due to:

- Reluctance on the part of the farmers in reporting cases.
- lack of awareness in rural areas of the state
- distance of the clinic(s) from their villages
- Inappropriate recording of cases in the clinic.
- Notification inefficiency was observed in the second and third tier of the disease reporting system due to
 - Negligence and failure to submit all the reports received to the state monitoring officers.
 - Inability of the system to fully incorporate the private practitioners

Speed of data reported: Speed of reporting was slow, varying from 2 weeks to 4 months from date of occurrence to date of reporting.

The major impediments identified included:

- a. poor awareness by farmers of the need for prompt disease notifications,

- b. too long chain of reporting,
- c. inadequate qualified veterinary personnel,
- d. lack of communication facilities and
- e. Poor diagnostic facilities.

Conclusion

Animal Disease Reporting System in Oyo State, Nigeria was found to be inaccurate, grossly under-reported, late and Generally inactive between 1995 and 2005. Similar results have been reported in other parts of Nigeria.

Recommendations

For the effectiveness of the ADRS, now called National Animal Disease Information System (NADIS) to be attained and maintained in Nigeria, there is thus a very relevant need to promote alternative to the official disease reporting for effective disease outbreak diagnosis, monitoring, surveillance and control.

One of such relevant informal alternative is ProMED-mail (the Program for Emerging Diseases) (<http://www.promedmail.org>), a program of the International Society for Infectious Diseases (www.isid.org), which is

- A daily web- and e-mail-based reporting system distributed by email to direct subscribers and posted immediately on the ProMED website. Currently reaches over 55,000 subscribers in at least 185 countries
- Provide up-to-date and reliable news about threats to human, animal, and food plant health around the world, seven days a week.
- Central purpose of ProMED is to promote communication amongst the international infectious disease community, including scientists, physicians, veterinarians, epidemiologists, public health professionals, and others interested in infectious diseases on a global scale (Woodall *et al* 2010).
- regional and sub-regional initiatives:
 - ProMED-PORT in Portuguese, which covers Brazil and Portuguese-speaking Africa;
 - ProMED-ESP in Spanish, which covers Latin America;
 - ProMED-RUS in Russian, covering the Newly Independent States of the former Soviet Union;
 - PRO/MBDS in English, covering the 6 countries in Southeast Asia bordering the Mekong river; and
 - ProMED-FRA in French covering French-speaking West Africa. ProMED-mail.
 - ProMED-EAFR covering Anglophone English-Speaking Africa

The start off of ProMED-East Africa- now ProMED- Anglophone Africa- (<http://eafr.promedmail.org>), is a welcomed and much needed response to improving the poor disease notification/ reporting in Nigeria and other parts of Africa.

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Detection of *Listeria monocytogenes* from in Mixed Cultures of Isolates from a West African Soft cheese 'wara' Using Oligonucleotide Primers Targeting the Genes Encoding Internalin AB

Adetunji V.O

Department of Veterinary Public Health and Preventive
Medicine University of Ibadan, Ibadan
Nigeria

Introduction

Listeria monocytogenes is a facultative, Gram-positive bacteria that can cause severe diseases in immunocompromised individual (Cocolin, *et al.*, 2005). It causes the disease called listeriosis: a food-borne disease with high mortality rates ranging between 26-30% (Cocolin *et al.*, 2005; Guilbaud, *et al.*, 2005). A mortality of 27% was reported in Northern Nigeria by Onyemelukwe *et al.* (1983). Mead *et al.*, (1999) reported that approximately, 2,500 human listeriosis cases occur annually in the United States, with about 500 deaths. An outbreak of listeriosis in a herd of cattle associated with stillbirth, abortion, nervous signs and death has been reported in Nigeria by Akpavie and Ikheloa (1992). Other reports of occurrences have been made by Terplan *et al.*, 1986; Farber *et al.*, 1987; Pin and Gillbert, 1980; Loncarevic *et al.*, 1995; Massa *et al.*, 1990. Until recently, food-borne listeriosis was commonly regarded as an invasive disease that affected only susceptible population groups. It was considered to be associated with bacteremia only in certain target organs and was only rarely associated with gastrointestinal symptoms (Slutsker and Schuchat, 1999). However, the upsurge in the antibiotic resistance of *L. monocytogenes* and recent reports of a new, noninvasive form of listeriosis that causes febrile gastroenteritis increase the public health significance of *L. monocytogenes* (Peterkin *et al.*, 1991; Dalton, *et al.*, 1997; Aureli *et al.*, 2000).

The quantification of *L. monocytogenes* has since been based on the use of a standard microbiological method. However, this method requires up to 3 days for quantification of *L. monocytogenes*. Therefore, for rapid enumeration of *L. monocytogenes*, a DNA-based method such as PCR, has been considerably developed (Almeida *et al.*, 2000). *L. monocytogenes* has been quantified using different PCR-based methods. Examples are the use of a 5'-nuclease PCR-base method targeted at the *hlyA* and *actA* genes respectively (Nogva *et al.*, 2000; Oravcova *et al.*, 2005). Also the use of real-time PCR to detect and quantify *L. monocytogenes* in biofilms has been reported by Guilbaud *et al.*, (2005). The presence of the virulence gene Internalin A (InIA) has been identified with *L. monocytogenes* (Pentecost *et al.*, 2006).

All of the identified virulence genes in *L. monocytogenes* are known to be under direct or partial control of positive regulatory factor A (PrfA) (Mengquad *et al.*, 1991). Entry into nonprofessional phagocytes is mediated by surface-associated gene products internalin A and B (Dramsı *et al.*, 1997). The bacterial surface protein Internalin A (InIA) interacts with the host protein E-cadherin, located below the epithelial tight junctions at the cell-to-cell contacts (Pentecost *et al.*, 2006). InA is necessary for invasion of epithelial cells and is sufficient to reconstitute invasion when expressed in the non-pathogenic and non-invasive species, *Listeria innocua* (Gaillard *et al.*, 1991; Lecuit *et al.*, 1997). A second type Internalin B (InIB) which binds the extracellular domain of c-Mets, a receptor tyrosine kinase acts synergistically with InIA during invasion of cultured epithelial cells through an unknown mechanism (Bergmann *et al.*, 2002). This work therefore identified the virulent genes (Internalin A and B genes) in pure culture to test the specificity of the polymerase chain reaction (PCR) assay.

Materials and Methods

Enumeration Bacterial strains

Listeria monocytogenes and other gram positive strains (*Listeria innocua*, *Listeria ivanovii*, *Staphylococcus aureus* and *Bacillus cereus*) laboratory stock isolates from West African soft cheese 'wara' were used in this study. They were enumerated using methods by Barrow and Feltham, 1993. The control strain (*Listeria monocytogenes*-Sara Lee) was associated with human disease outbreaks and was provided by Dr Jinru Chen of the Center for food safety and Department of Food Science and Technology, University of Georgia, Griffin campus.

Enumeration of *Listeria monocytogenes* for PCR

The 5gram 'wara' cheese samples were homogenized with 10ml sterile peptone water. One ml of the homogenate was then inoculated on modified oxford agar base (MOX) supplemented with modified oxford antibiotic supplements (acriflavine, nalidixic acid and cycloheximide) (Becton, Dickinson and Company). The inoculated plates were incubated at 37°C for 24 h. Esculin producing colonies were purified and identified according to Barrow and Feltham, 1993. Subsequently a colony of confirmed *L. monocytogenes* cultures was plicate to ensure accuracyn d d Bothesons transferred into 10 ml tryptic soy broth (TSB), respectively.

Purification and confirmation of *Listeria* isolates from wara

Listeria was purified by sub-culturing 3 times on tryptose soy agar. After which confirmation of isolates were done using *Listeria* specific antisera to confirm *L. monocytogenes*. Positive coagulation reactions were observed with *L. monocytogenes* specific antisera.

Identification of internalin genes AB by polymerase chain reaction

DNA isolation /bacteria template preparation

To test the specificity of PCR assay, 100µl (1ml) of overnight- grown cell cultures of 11 pure culture and a control in Tryptose soy broth at 37°C was centrifuged for 3min at 12,000 x g with a bench top centrifuge (Model 5415c, Eppendorf, Hamburg, Germany). The supernatant was decanted and the cell pellets were re-suspended in 100µl sterile distilled water and centrifuge again for 3min at 12,000 x g. The cells were again re-suspended in 100ul of sterile distilled water and then heated for 10minutes in boiling water bath. The suspension was centrifuged again for 6 minutes (12,000 x g) to collect supernatant fluid from heat-treated samples. Supernatant fluid (the DNA extract) about 70 µl was pipetted and put into new sterile eppendorf tube and saved on the counter. Five micro liters of this supernatant fluid was then put in new 1ml microfuge tubes and used as a DNA template for PCR amplification.

Polymerase Chain Reaction (PCR)

Oligonucleotide primers were previously designed with computer software primer premier (Palo Alto, Calif.) and synthesized by GIBCO BRL (ROCKVILLE, MD.). The sequences are shown in table 1. A DNA Thermal cycler (Model 480; Perkin Elmer Cetus, Norwalk, Conn.) was used for PCR amplification. A 50ul aliquot of PCR buffer contained 1 U of Taq DNA polymerase (ROCHE), 0.2mM of each deoxynucleoside triphosphate, 1.5 Mm of MgCl₂, 1M of each primer, 5ul of DNA template, and dH₂O. DNA templates were heated at 94°C for 5 min and then (annealing) amplified for 30cycles, each consisting of 94°C for 2min, 55°C for 1min, 72 for 1min, 0°C for 0min. Holding at 4 °C followed by a 10 minutes final extension at 72 °C. Samples were finally soaked at 4°C holding temperature. Amplified products were electrophoresed on 1% agarose gel (GIBCO BRL, Gaithersburg, Md.) in 1 x Trisborate- EDTA buffer (0.089 M Tris-borate and 0.002 M EDTA, Ph 8.0), stained with ethidium bromide (1ul/ml), and photographed with the Gel Doc System 2000 (Bio-Rad laboratories, Hercules, Calif.). The DNA standard for gel analysis was a 100-bp DNA LADDER (Roche). In a positive sample, discrete bands co-migrated with the PCR product of the positive control. Identification of the internaline AB genes was confirmed with reference to the standard makers.

Table 1: Sequences of primers derived from the genes encoding *Listeria internalin AB*

Target	Primers	Sequence (5' to 3')	Position
Internalin AB	AB1	CTTCAGGCGGATAGATTAGG	332-351
Internalin AB	AB3	TTCGCAAGTGAGCTTACGTC	1214-1233C

Results

PCR-based Method for Detection of Internalin genes

The result of the amplification of internalin gene- ABI-CTTCAGGCGGATAGATTAGA position 322.351 and AB3-

TTCGCAAGTGAGCTTACGTC position 1214-1233c with invasive characteristics by polymerase chain reaction shows that 6 of the 11 strains were positive using the 100bp ladder at a molecular weight of 920kb (Table1; Figures, 1 and 2). The negative strains were either non *Listeria spp* or not *Listeria monocytogenes*

Discussion

The presence of *Listeria spp* in soft cheese might be as a result of post processing contamination of cheese by the cheese handlers from the environment during exposure. The inactivation of *Listeria* under conditions of pasteurization was also reported by Schaack and Marth (1988). The ubiquitous nature of *Listeria spp* makes it possible to easily contaminate soft cheese (Weis and Seeliger, 1975). Internalin AB virulence genes were identified in 6 *Listeria monocytogenes* strains using the 100bp ladder at a molecular weight of 920kb but in contrast the PCR product was not detected in other *Listeria spp* or in gram positive non *Listeria spp*. This indicates that the primer set was highly specific for *Listeria monocytogenes*. *L. monocytogenes* causes invasive disease by crossing the intestinal or tissue barrier. This process depends on the interaction between the bacterial surface protein internalin A (Pentecost *et al.*, 2006). Internalin InIA has been shown to interact with host cell E-cadherin to mediate invasion of mammalian epithelial cells, in particular the intestinal epithelia cells (Vazquez-Boland *et al.*, 2001), therefore the isolation of and identification of internalin gene internalin ABI-CTTCAGGCGGATAGATTAGA position 322.351 and AB3- TTCGCAAGTGAGCTTACGTC position 1214-1233c in 6 of the these foodborne strains is of great public health significance. This PCR technique also provides a rapid detection of *Listeria monocytogenes* in a mixture of bacteria cultures which will be useful in food safety applications.

Acknowledgement

We acknowledge Dr Jinru Chen for provision of primers and control strains

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Figure 1: Gel electrophoresis showing 5 positive *Listeria monocytogenes* strains (1-5) against the 100bp marker (A & B) and *Bacillus cereus* (C) is negative



Figure 2: Gel electrophoresis showing 1 positive *Listeria monocytogenes* strain (B) against the 100bp marker (A & C). *Listeria innocua* (1), *Listeria ivanovii* (1), *Staphylococcus aureus* (2) and *Bacillus cereus* (C) are negative

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Probiotic Effect Of Yeast (*Saccharomyces cerevisiae*) on Hen-day Egg Performance, Total Serum And Egg Cholesterol Levels In Laying Chicken

C. Ezema

Department of Animal Health and Production
Faculty of Veterinary Medicine
University of Nigeria, Nsukka
Nigeria

Background of the Study

In most developing countries, there is decreasing animal protein intake as a result of poverty and overpopulation. Thus, the great need for a radical approach to livestock production. The present daily protein allowance for Nigerians according to Atsu *et al.* (2002) has decreased from 14g to 4.5g of protein per head per day which is abysmally low compared to the FAO (1997) recommendation of 35 gm of animal protein per head per day. Measures to solve this problem are geared towards improving the production of livestock species that have the potential for rapid growth rate and short generation time such as poultry (Smith, 1990). While efforts are made to increase production, the problem of insufficient animal protein intake is further compounded by the fear and refusal to eat eggs because of its cholesterol content. This phobia is due largely to ignorance especially among the people of the developing world.

Probiotic use has gained widespread interest since the finding that newly hatched chicks could be protected against colonization by *Salmonella enteritidis* by dosing a suspension of gut contents derived from healthy adult chicken (Nurmi and Rantala, 1973).

However, the mechanism of action of probiotics is not yet clearly understood and is still subject to further research, though there are several hypotheses (Ahmad, 2006).

Objectives of the Study

1. To determine the effect of this probiotic on hen-day egg performance.
2. To evaluate the effect of probiotics (*S. cerevisiae*) supplementation on serum and egg cholesterol levels.
3. To determine the optimum level of inclusion of the probiotic in the pullet's diet for minimum serum and egg cholesterol levels and maximum egg production.

Significance of the Study

In addition to increasing the quantity of eggs produced, the fact that this probiotic can reduce egg cholesterol level may encourage people especially in developing countries to consume more eggs and enjoy good health as well as other benefits derived from chicken egg.

Materials and Method

A total of 100 layers were randomly divided into 4 groups (A, B, C and D) of 25 birds each. The diets for groups A, B and C were supplemented with probiotic at varied levels of 0.6g/kg, 0.8g/kg and 1.0g/kg of feed, respectively. Group D diet had no probiotic (Control). The layers were given 120 g of feed per bird per day in two divided doses (morning and afternoon). Eggs were collected three times daily (morning, afternoon and evening). All the eggs collected from each group were weighed and recorded daily. Five birds were randomly selected from each group and about 3.0 ml. of blood was collected from each bird. The blood samples were allowed to clot in a sample bottle and serum harvested was used to determine the total serum cholesterol content with the aid of a commercial kit. Five eggs were also randomly collected from each group and used to determine the total egg cholesterol content following standard procedure.

Results

The results of serum cholesterol level, egg cholesterol level and hen-day egg performance are presented in Table 1. The results showed that group C had a significantly ($P \leq 0.05$) higher hen-day egg performance of 85%, followed by group B with 70% hen-day performance. Group A recorded a hen-day performance of 68%, while group D (the control) had the lowest hen-day performance of 65%. Probiotic-fed groups (A -0.6g yeast/kg, B - 0.8g yeast/kg, and C - 1.0g yeast/kg) had significant ($p \leq 0.05$) reduction in serum cholesterol level than the control (group D). The lowest mean serum cholesterol level was group A (108.33 \pm 9.28 mg/dl). While group D (control) had a significantly ($p \leq 0.05$) higher mean serum cholesterol level of 166.67 mg/dl.

Eggs from the supplemented groups also had significantly ($P \leq 0.05$) lower cholesterol content compared to the control. Their egg cholesterol levels were (A-D) 510.60 \pm 7.50, 595.70 \pm 6.43, 476.60 \pm 9.84 and 824.50 \pm 3.86, respectively. Thus, group C eggs had the least cholesterol content (476.60 \pm 9.84) and Group D (control) eggs had the highest cholesterol content (824.50 \pm 3.86).

Table 1.: Serum, egg cholesterol levels and hen-day egg performance of layers fed diet supplemented with varied levels of probiotic.

	Group A 0.6 g yeast/kg	Group B 0.8 g yeast/kg	Group C 1.0 g yeast/kg	Group D No yeast (Control)
Serum Cholesterol (mg/dl)	108.33 \pm 9.28	115.00 \pm 14.34	112.67 \pm 7.88	166.67 \pm 6.82
Egg Cholesterol (mg/dl)	510.60 \pm 7.50	595.70 \pm 6.43	476.60 \pm 9.84	824.50 \pm 3.86
Hen Day Egg Performance (%)	68.00 \pm 9.35	70.00 \pm 9.35	85.00 \pm 10.00	65.00 \pm 5.00

Discussion

There was significant increase ($P \leq 0.05$) in egg production among the probiotic supplemented groups A, B, and C. Group C had the highest hen-day egg performance of 85.00 \pm 10.00. This result agrees with earlier reports by Glade and Sist (1988), Martin *et al* (1989), Adejumo *et al* (2005) and Ezema (2007) who differently observed that probiotic improves efficiency of feed utilization in livestock.

The results also revealed that probiotic fed groups (A-0.6g yeast/kg, B-0.8 yeast/kg and C- 1.0 yeast/kg) showed significant ($P \leq 0.05$) reduction in serum cholesterol level than the control (group D). Reduction in circulating cholesterol with supplemental yeast (*S. cerevisiae*) was remarkable and agrees with the results of other researchers (Onifade *et al*, 1999; Onifade, 1997) that the addition of innocuous micro-organisms including yeast to diets of rabbits and broiler chickens decreased serum cholesterol, triglycerides and phospholipids. De Smet *et al*. (1994) reported that probiotics could contribute to the regulation of serum cholesterol concentration by deconjugation of bile acids. Since the excretion of deconjugated bile acid is enhanced and cholesterol is its' precursor, more molecules are spent for recovery of bile acids. As a result of increased synthesis of these acids, it is expected that the level of serum cholesterol will be reduced. Klaver and Van Der Meer (1993) also suggested that co-precipitation with bile acid might be of importance in decreasing serum cholesterol concentrations.

Conclusion

The probiotic (*S. cerevisiae*) at an appropriate level of inclusion significantly reduced serum as well as egg cholesterol levels and improved hen-day egg performance.

Recommendation

Probiotic (*S. cerevisiae*) inclusion level of 1.0g/kg of layers mash was recommended for optimum hen-day egg performance and minimum serum and egg cholesterol content.

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Conference News

The 5th Pan Commonwealth Veterinary Conference Accra, Ghana on 21-25 March 2011

The 5th Pan Commonwealth Veterinary Conference was held from the 21st to 25th March, 2011 at Accra, Ghana. The theme of the conference was “**The Role of Veterinarians and Livestock Farmers in Food Security and Poverty Alleviation**”.

The conference was inaugurated by Dr. Bernard Vallat, Director General OIE. It was the first major international veterinary conference in ‘**Vet 2011: World Veterinary Year**’ celebrating 250 years since the establishment of the world’s first veterinary school in Lyon, France, in 1761.

The Ghana Veterinary Medical Association jointly organised this conference with CVA. A total of 750 delegates from all over the world including those from the host nation Ghana and from other African countries such as Nigeria, Gambia, Cameroon, Ivory Coast, Tanzania, Uganda, South Africa, Namibia, Botswana, Malawi, Lesotho, Swaziland, Zambia, Mauritius, Niger, Mali, Sudan, Tunisia and many more from United Kingdom, Cyprus, Malta, India, Pakistan, Sri Lanka, Australia, Malaysia, Singapore, New Zealand, Pacific Island Countries and Canada and Caribbean countries attended the conference.

The conference had an exciting, vibrant and informative Scientific Programme with sessions focussing on One World One Health, Food Safety and Security, Veterinary Education, the Future of livestock in Africa and Advances in Veterinary Science, The role of women in livestock development, and Zoonotic Diseases will be discussed as well as other topics such as alleviation of poverty, wildlife conservation, and aquaculture.

The programme was held in conjunction with a number of Workshops and Specialist Sessions such as Rabies, Animal Welfare, and Welfare of Working Animals.

Speakers for the sessions were drawn from various international Veterinary organisations and institutions such as OIE, FAO, Institute Caporale, WHO, EU, Bristol University, Onderstepoort Veterinary Faculty, ILRI, WSPA, CIWF, ARC etc.

A Trade Exhibition featuring various pharmaceutical and vaccine manufacturing companies will also be held.

The Executive Committee of the CVA met on 20th March, 2011 and elected the following as office bearers for the year 2012-2015

Dr. S. Abdul Rahman, Secretary, CVA - President
Dr. Karen Reed, RR UK/Mediterranean Region - Secretary
Dr. Bob McCracken - Programme Director

Dr. S. Abdul Rahman

Dr. S. Abdul Rahman graduated with a bachelor’s degree in Veterinary Science from Mysore Veterinary College, Bangalore in 1965 and a Masters from University of Madras in 1969 and PhD in Veterinary Parasitology from University of Queensland, Australia in 1976. He was awarded the Fellowship of the Royal Veterinary College, Spain in 1990.

Dr Rahman has published more than 100 scientific papers and has authored a book on Veterinary Parasitology. His current interests include Veterinary Public Health especially involving Zoonosis to include control programmes for Rabies, Hydatidosis, Cysticercosis and Epidemiology and Control of Emerging Diseases, and Animal Welfare.

Dr. Rahman served as President of Karnataka Veterinary Association, and as Secretary and Vice President of Indian Veterinary Association for 16 years and also served as the Council Member of India to the Commonwealth Veterinary



S Abdul Rahman

Association and Permanent Member representing India at the World Veterinary Association and Federation of Association of Veterinarians of Asia.

He has participated and presented papers and chaired sessions at numerous national and international conferences on various topics ranging from Veterinary Parasitology, Veterinary Education, Control of Rabies and Animal Welfare all over the world.

He is a member of the World Organisation for Animal Health (OIE) Working Group on Animal Welfare, and was the Chairman and a Member of OIE Ad hoc Group on Stray Dog Control The Ad hoc group was responsible for the OIE guidelines on Dog population management He is the Executive Director of the Alliance for Rabies Control (ARC), UK.

Dr. Karen Reed

Ms Karen qualified from the Royal Veterinary College, London in 1987 and then spent 3 years in mixed, mainly large animal practice, in Herefordshire. In 1990 she was posted to Nepal for 3 years with VSO (Voluntary Service Overseas), where she taught animal health at an agricultural vocational training school, as well as spending the last 5 months of the posting as VSO Field Officer.



Karen Reed

In 1993/94 Karen completed an MSc. in Tropical Veterinary Medicine at CTVM (Centre for Tropical Veterinary Medicine) at Edinburgh University (where she received a distinction and the Grieg Medal) and was then posted to Jordan as an Associate Professional Officer (APOS) with ODA (Overseas Development Administration, now DfID). She worked on a joint ODA/Jordanian Government project in the eastern desert looking at improving the health and productivity of Bedouin sheep flocks. In 1999 she returned to mixed practice in the UK in North Yorkshire.

In 2002 Karen was appointed Veterinary Director for SPANA (Society for the Protection of Animals Abroad) where she worked until 2010 and then joined The Brooke Equine Welfare Charity as the Head of Welfare and Research where she is currently working. She was also the former

Chair of the BVA Overseas Group.

Dr. Bob McCracken

Dr Robert McCracken graduated from Edinburgh University in 1966 and gained his PhD from Queen's University Belfast in 1968. After a period in mixed practice, he joined the State Veterinary Service, embarking on a career which would span 30 years and culminate in him becoming Chief Veterinary Officer (CVO) for Northern Ireland from 1998 - 2002.



Bob McCracken

Dr McCracken was awarded the gold medal for being the most outstanding student in his final year, and during his varied career has lectured extensively in the Faculty of Agriculture and Food Science at Queen's University Belfast and has also had periods of working abroad. As CVO he was at the forefront of the fight against the foot-and-mouth and BSE outbreaks and was instrumental in enhancing Northern Ireland's animal traceability system. He has served as President of the North of Ireland Veterinary Association, the Association of Veterinary Teachers and Research Workers of Great Britain and Ireland, the Poultry Association of Northern Ireland, Agrarian Society and as the President of the British Veterinary Association from 2004-05. Dr McCracken was appointed as the Programme Director in 2008 and with this re-election he will be serving a second term of office.

The CVA Council Meeting was held on 21st March, 2011 and all the CVA councillors participating in the conference attended the meeting.

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