CONTROL OF PPR DISEASE:
CHALLENGES AND OPPORTUNITIES

Proceedings

National Conference on PPR Disease

held on November 28-29, 2014

BAIF DEVELOPMENT RESEARCH FOUNDATION

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An Indian Foundation committed to Livestock Development and Poverty Alleviation

BAIF Development Research Foundation (BAIF) is a Research Foundation established in 1967 by Dr. Manibhai Desai, a disciple of Mahatma Gandhi, at Urulikanchan, near Pune to promote sustainable livelihood in Rural India.

BAIF's Vision is to build a self-reliant rural society assured of food security, safe drinking water, good health, gender equity, low child mortality, literacy, high moral values and clean environment. BAIF's Mission is to create opportunities of gainful self-employment for the rural families, especially disadvantaged sections, ensuring sustainable livelihood, enriched environment, improved quality of life and good human values. This is being achieved through development research, effective use of local resources, extension of appropriate technologies and upgradation of skills and capabilities with community participation. BAIF is a non-political, secular and professionally managed organisation.

Innovative models of micro-enterprises have been evolved to ensure inclusive development through dairy husbandry, goat production, agri-horti-forestry and sustainable agricultural production for food security and poverty alleviation. Formation of producers' groups, empowerment of women and environmental sustainability cut across all these programmes. Most of these programmes are serving as result demonstrations for wider replication across the country.

BAIF has developed the Village Cluster Development Approach to reach the poorest of the poor. To facilitate backward and forward development and to ensure sustainability, self help groups of men and women of homogeneous socio-economic status are being promoted. These groups have identified various on-farm and non-farm income generation activities to boost their income further. BAIF is providing services to over 5.0 million small and marginal landless families spread over one lakh villages in 16 states in the country. Apart from over 4000 staff engaged by BAIF, there are over 2500 self employed youth, para-veterinarians, field guides and members of People's Organisations and their federations who are mentoring the beneficiaries at the grassroot level.

BAIF is engaged in Livestock Development over the last five decades and committed to transfer appropriate technologies and good husbandry practices to small livestock owners while conserving the precious native breeds of cattle and buffaloes. BAIF has been a pioneer in promoting livestock breeding services at the doorstep of small farmers across the country since long. More than 4.5 million small and marginal farmers are availing Animal Husbandry services in over 100,000 villages under BAIF's programme while 2.0 million high yielding cows and buffaloes are in milk production, contributing over Rs. 6000 crores to the GDP annually. The programme has demonstrated the feasibility of enjoying sustainable livelihood by maintaining three dairy animals. BAIF has revived goat husbandry in the country through an eco-friendly goat husbandry model, with formation of goat keepers' groups facilitated by local field guides.

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Organised by:

Indian Council of Agricultural Research

Department of Animal Husbandry, Dairying and Fisheries (DADF), Government of India

Global Alliance for Livestock Veterinary Medicines (GALVmed)

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Preface

India is an agrarian country and over 75% of the farmers being small and marginal landholders, they are heavily dependent on livestock to raise supplementary income for their livelihood. Unfortunately, a majority of the livestock is unproductive and prone to series of diseases resulting in huge economic losses. Among these diseases, *Peste des Petits Ruminants* (PPR) is an economically important disease particularly for small farmers and landless who maintain sheep and goats for their livelihood.

Even with excellent networking of veterinary services and good quality vaccines available in the country, our farmers are not able to take advantage of these services, resulting in high mortality ranging from 30-60%. Hence, it is proposed to establish a National Scientific Forum to ensure interaction among all the stakeholders - farmers, scientists, producers of biologicals and field functionaries for identifying the challenges in the field and to find suitable solutions.

As a first step, a National Conference on PPR Disease was organised on November 28-29, 2014 in New Delhi with the support of the Indian Council of Agricultural Research and the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India as Co-Organisers along with Global Alliance for Livestock Veterinary Medicines (GALVmed), an international Foundation engaged in supporting the developing countries to control livestock diseases and BAIF Development Research Foundation, committed to livestock development and poverty alleviation. The conference was sponsored by MSD Animal Health, Indian Immunologicals and Hester Biosciences. The objective was to provide an opportunity to various stakeholders to share their problems and experiences which would be helpful to evolve a suitable strategy through the proposed Forum.

The conference was attended by Experts from International Organisations representing OIE, Paris, ILRI, Nairobi, Pirbright Institute (World Disease Reference Laboratory), UK, IFAD, GALVmed, UK, MSD Animal Health, the Netherlands, and senior scientists and officials from the Ministry of Agriculture, Indian Council of Agricultural Research,Indian Veterinary Research Institute, Central Sheep and Wool Research Institute and National Institute of Veterinary Epidemiology and Disease Informatics, Scientists from Animal Science Universities, Veterinary professionals of various State Animal Husbandry Departments, Regional Disease Diagnostic Laboratories, Senior Executives and scientists from Vaccine Production Firms and Civil Society Organisations.

The experts focussed their discussions on the nature of disease outbreaks, extent of economic loss, various initiatives taken by the government and non-government agencies and their impact on the disease control, status of vaccine availability and new initiatives taken to produce improved quality vaccine and the awareness of farmers about disease control. They also came out with important recommendations for effective control of the disease. The delegates unanimously expressed that a Scientific Forum can be very helpful for mobilising all the stakeholders to work together with focus on eradication of PPR from the country.

We are grateful to the Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries and Indian Council of Agricultural Research, Government of India, our Sponsors, all the International and Indian Organisations and all the Delegates for their valuable contribution and support. We hope this initiative will help to eradicate PPR and enable our small ruminant keepers to improve their livelihood.

BAIF and GALVmed team

EXECUTIVE SUMMARY AND RECOMMENDATIONS

Preamble:

PPR is an important disease of small ruminants in India, which is threatening the livelihood of a large number of small land holders, landless and women headed families in the country. To establish a robust platform for control of this disease through a coordinated effort, a National Conference on PPR Disease was organised in New Delhi on November 28-29, 2014.

The conference was organised with the support of the Indian Council of Agricultural Research and the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India as Co-Organisers along with GALVmed and BAIF. Generous support was received from GALVmed, Intervet International, Indian Immunologicals and Hester Biosciences.

The conference was inaugurated by Dr. S. Ayyappan, Director General, ICAR in the presence of international experts, research scientists, State Animal Husbandry Departments, representatives of public and private vaccine manufacturers and civil society organisations. Prof. Suresh S. Honnappagol, Animal Husbandry Commissioner, Government of India, presided over the function. The Lead Speakers at the inaugural session included Dr. Peter Jeffries, CEO, GALVmed, Dr. Hameed Nuru, Senior Director, Policy and External Affairs, GALVmed, Mr. Girish G. Sohani, President, BAIF, Dr. Narayan G. Hegde, Trustee and Principal Adviser, BAIF and Dr. Mamta Dhawan, Regional Manager, South Asia, GALVmed. The Keynote Addresses were delivered by Dr. Philip Toye, Principal Scientist and Theme Leader - Animal Health, ILRI, Nairobi and Dr. Joseph Domenech, OIE, Paris.

The focus of this conference was to assess the status of the problem caused by the disease and various initiatives made by different agencies particularly, the Central and State Governments, Research Institutions, Animal Science Universities, Private and Voluntary sectors and Farmers' Organisations, and to evolve a strategy for initiating a well-coordinated programme, through a National Scientific Forum.

The conference was attended by 8 International Experts representing OIE, Paris, ILRI, Nairobi, Pirbright Institute (World Disease Reference Laboratory), UK, GALVmed, UK, MSD Animal Health, the Netherlands and 60 senior scientists and officials from the Ministry of Agriculture, Indian Council of Agricultural Research, Indian Veterinary Research Institute, Central Sheep and Wool Research Institute and National Institute of Veterinary Epidemiology and Disease Informatics, Scientists from Animal Science Universities, Veterinary professionals of various State Animal Husbandry Departments, Regional

Disease Diagnostic Laboratories, Senior Executives and scientists from Vaccine Production Firms and Civil Society Organisations.

The delegates focussed their presentations on the following issues:

- ✓ Current PPR Disease status and its impact on the economy;
- ✓ On-going Research on Diagnosis and Vaccine production;
- ✓ Challenges of PPR Vaccination and Disease Control;
- ✓ Strategy for PPR Control in India
- ✓ Role of a National Scientific Forum for control of PPR.

Highlights of the Presentations and Discussion

1. ***Peste des Petits Ruminants* Control Programme (PPR-CP):** Realising the gravity of PPR disease, the Government of India has been implementing PPR disease control programme in all the states and Union Territories. The programme was further strengthened in 2014-15 by providing funds for procurement of vaccine, mass vaccination, strengthening of ELISA labs, supporting information, education and communication (ECT) technology services, purchase of animal identification and health cards, necessary equipments, consumables, etc. The Ministry of Agriculture is also supporting the Research Institutions for undertaking surveillance and monitoring under this programme. Premier institutions of ICAR - Indian Veterinary Research Institute, Central Sheep and Wool Research Institute, Central Institute for Research on Goats and National Institute of Veterinary Epidemiology and Disease Informatics are also engaged in disease diagnosis, development of improved diagnostics and vaccines, disease surveillance and assessment of disease impact on the rural economy.

2. Inspite of serious efforts made by the Government of India and State AHDs, PPR, with 34% mortality, is the most serious disease in small ruminants, highly endemic in India. It has a huge impact on the livelihood of small and marginal farmers. However, the disease outbreaks are not being reported correctly due to poor communication network and various other reasons. Often, it is only when farmers and the media raise their voices that immediate reporting and follow-up vaccinations are undertaken. However, such efforts are very sporadic with very limited impact.

3. Proper recording of disease outbreaks and their socio-economic impact should be documented for correct assessment of the damage to enable policy makers to come up with a suitable solution.

4. Awareness is the key to control: Awareness among farmers about the disease, seasons of outbreak, availability of vaccine, quarantining newly brought animals and segregation of suspected animals should be created. A toll free number may be assigned for direct reporting about the disease outbreak by the farmers/local Government/community organisations to a State Agency to ensure timely reporting and action.

5. Disease outbreak occurs during certain seasons in different regions, mostly in March-April and after the onset of monsoon, with some variation from region to region. Hence, district-wise disease outbreak mapping should be prepared for planning an elaborate control programme.

6. Considering that major outbreaks take place in April-June, vaccination in December-February before the outbreak is recommended. Vaccinating in winter will help in better maintenance of cold chain and significantly reduce damage to vaccine during its use in the field.

7. Early diagnosis in the field will be helpful in effective disease control. This can be followed by Ring vaccination to cordon off the infected area. Targeted mass vaccination, consecutively for 2-3 years, covering all unvaccinated sheep and goats in Andhra Pradesh, Karnataka and Chhattisgarh has been effective in controlling the disease significantly. These success stories need to be properly documented and shared across the country for cross learning.

8. Vaccinations should cover kids above 3 months of age and all unvaccinated animals. Vaccination should be done after deworming. Animal registration card including health and vaccination details for each animal or herd may be maintained to find out the history and vaccination status.

9. Sheep and goat are infected by the same strain - 'Sungeri-96'. However, the impact is more severe in goats than in sheep.

10. Inter-state movement of sheep is a serious problem. These flocks, often unprotected by vaccination, are prone to infection and spread of the disease. Special preventive and control measures should be developed and the shepherd communities should be trained to adopt recommended practices.

11. Good quality vaccine for PPR is being produced in India. However, the existing infrastructure in the field for cold storage is inadequate. Therefore, development of thermo tolerant PPR vaccine should be given priority.

12. Efforts are also being made to develop nasal vaccine which will be more effective and easy for vaccination even by semi-skilled paravets. Production of recombinant vaccine and marker vaccine may be explored. IVRI is already planning to develop a multiple vaccine for Goat pox and PPR. Use of DIVA vaccine though expensive, can be helpful in the last phase of disease eradication.

13. Packaging of vaccines in 25 and 50 doses will also be helpful in avoiding wastage of vaccine. Training of vaccinators and para-vets in vaccination and storage of vaccine should be given priority, by involving the vaccine manufactures.

14. Veterinary services should be strengthened to support the field network in differential diagnosis, deworming, vaccination and sero-monitoring of the vaccinated animals. Disease Investigation Laboratories already established in the field should be strengthened to provide rapid diagnostic services.

15. RT-LAMP assay developed for detection of PPRV offers advantages of high sensitivity, rapidity and ease of performance under isothermal conditions. This test can be cheaper than the 'penside' test for early diagnosis.

16. There is a need for a strong surveillance system to report outbreaks and to monitor disease control through vaccination and movement of animals across the districts/state.

17. Coordination between the Policy Makers, State Veterinary Services, field technicians and farmers is the key to control the disease. Role of private and voluntary sectors needs to be reviewed so that they can contribute their best to help the farmers.

18. The programme should have a firm policy commitment and legislative back up. Students of veterinary colleges may be engaged for 1-2 weeks for annual vaccination campaign and wide publicity given through mass media. The Veterinary Council and State Governments authorities should be approached to permit lay vaccinators to undertake vaccination.

19. OIE has planned a global PPR eradication programme in 2015. Taking clue from the African PPR control programme, India should link its disease control programme with the global programme by preparing a blueprint for its control and eventual eradication of this disease.

National Scientific Forum on PPR

A brainstorming session was dedicated to the establishment of the PPR Forum in India. All the delegates expressed the need for establishment of a Scientific Forum with the following activities which can be helpful in controlling the disease.

1. There is a need for the Scientific Forum to promote PPR Disease Control on a Mission mode.
2. The forum should have the support of the Central and State Governments, institutionalized within the existing organisational structure and work as an autonomous organisation neutral to all the stakeholders.
3. Membership should be open to the representatives of the Government of India, Research Institutions, Universities and Training Institutions, Vaccine Manufacturers and Distributors, State Animal Husbandry Departments, Civil Society Organisations, Farmers' Organisations and Donor Organisations.
4. The forum should have the following Agenda:
   - ✓ Draft a National Strategy for disease eradication and provide technical advice to the State Governments on disease control;
   - ✓ Engage in Advocacy, Policy Development and Awareness and review the Minor Veterinary Services Act to include Vaccinators/Para-vets/Community Animal Husbandry Workers (CAHWs) for successful implementation of PPR vaccination campaign;
   - ✓ Facilitate cross learning of Success Stories and challenges encountered in disease control;
   - ✓ Serve as a Consultative body and a Support organisation for the Government and other stakeholders;
   - ✓ Approach the International Organisations engaged in disease control and livestock development in India for technical support;
   - ✓ Set up a dedicated Website for PPR. Develop a standard procedure / Manual for management and control of PPR disease and maintain it on the website. Prepare a Panel of Resource Persons to address questions posed by stakeholders/farmers.
   - ✓ Prepare a baseline report on PPR Status in India, based on secondary data and identify the priority areas of research and periodic field studies on economic losses and socio-economic impact of PPR outbreaks in different regions;
   - ✓ Facilitate technical collaboration for the Pubic and Private Biological Units required for technology upgradation for production of vaccines and biologicals.
5. The Forum should have long and short term Action Plans. It should also identify the resources to carry out the activities independently. ■

INAUGURAL SESSION

Welcome: Dr. Narayan Hegde, Trustee and Principal Adviser, BAIF

Small ruminants are an important source of livelihood and cash security for over 37.56 million small land holders and landless families in rural India. However, these livestock owners have not been tapping the potentials of this sector due to lack of technical and financial support from the development agencies and poor backward and forward linkages. BAIF Development Research Foundation, a civil society organisation, since its establishment in 1967 has been promoting genetic improvement of cattle and buffaloes to take up milk production as a source of sustainable livelihood. Development of small ruminants had very limited opportunity as most of the donors, including the development departments of the Government considered goat development to be detrimental to the conservation of biodiversity and forest resources.

However in 2005 at the invitation of the Government of West Bengal, BAIF initiated the goat development programme. Before planning a suitable programme, the problems encountered by the farmers were analysed and it was realized that high rate of mortality exceeding 50% due to PPR disease was the most serious problem. Good quality vaccine was available in the country but it was not reaching the farmers. With vaccination, the mortality came down to below 5%. With other good husbandry practices, the programme enabled the goat keepers to enhance their income by 3-4 times. The success of this programme enabled BAIF to replicate this programme in other states. While expanding the programme, we felt that the control of PPR should be an important aspect of goat husbandry programme across the country.

Fortunately after a few years, GALVmed came to work in India and included PPR in their development programme. BAIF requested GALVmed to join in sensitising stakeholders in goat husbandry and to establish their network in the form of a Forum and come up with a national agenda for eradication of goat disease from the country. We are extremely happy that the senior scientists of International Livestock Research Institute (ILRI), Nairobi and Office International des Epizooties (OIE), Paris are here to represent their Director Generals, as token of their support to this initiative. Another International Organisation, IFAD who is supporting the development of small ruminants in India has also extended its support. This conference aims at understanding the status of PPR disease and mobilizing

the stakeholders to share their views on establishing a National Scientific Forum, ultimately to eradicate this disease from India.

Opening Remarks: Mr. Girish Sohani, President, BAIF

PPR is a serious disease causing huge loss to farmers, but the level of awareness among farmers is low. The disease control programme particularly through timely vaccination in the field is very weak. Hence, there is a need to mobilize the entire community while strengthening extension and communication efforts to face the challenges. Control of the disease is more important because most of the 37 million families owning sheep and goat belong to weaker sections of the society and are heavily dependent on small ruminants for their livelihood. When small farmers lose their animals, it is a devastating loss for them as they would have lost everything. Hence, the disease has to be taken more seriously and concerted efforts need to be made to control it. We have good quality vaccines but the response for the usage is poor. This is the right time to set up a forum to link global partners with grassroot level farmers to eliminate the disease during the next 5-10 years.We are grateful to the Government of India, ICAR and all the partner organizations for supporting BAIF to take up this initiative.

Address by Dr. Peter Jeffries, CEO, GALVmed, Edinburgh, U. K.

GALVmed is working in the developing countries to combat livestock disease through development of vaccines and efficient delivery. We have also been studying the reasons behind the failure of the value chain in the field and build local capacities to take up the programme. In India, we have identified five different diseases of which PPR is one. This conference gives us an opportunity to review the on-going activities of various players and to identify the gaps. The time seems to be perfect as there are many organisations prepared to involve themselves in controlling the disease and we can work together to address the challenges through a coordinated approach. I am also happy that a large number of international scientists are participating in the conference along with Indian scientists and vaccine manufacturers. While adequate

funding may be available from the Government programme as well as from international donors, the logistics of reaching small farmers is a serious challenge. It is important for us to control this disease by involving all the stakeholders and bring relief to farmers.

Address by Prof. Suresh S. Honnappagol, Animal Husbandry Commissioner, Ministry of Agriculture, Government of India

Small ruminants represent 39% of the total livestock population in India and serve as moving banks of the small farmers and landless in rural India. Realising the economic loss caused by PPR, the Government of India launched a massive PPR Disease Control programme in 2010 with financial assistance to all the states. Under this programme, 460 million small ruminants have been vaccinated, using good quality vaccines produced by the Vaccine Production Laboratories both in the public sector and private sectors. The major problems are logistics of vaccine handling and lack of awareness among farmers in managing the disease. Hence, when the proposal of organising the National conference came from BAIF, we were extremely happy to support and strengthen the programme to rectify the missing links. We are sure with close coordination among various stakeholders, particularly through greater awareness among farmers and efficient delivery of vaccination service at their doorsteps, we can be successful in controlling this disease.

Presidential Address
Dr. S. Ayyappan
Secretary, Department of Agricultural Research and Education (DARE) and Director General, ICAR, Government of India

The Ministry of Agriculture,Government of India has been looking for an opportunity to partner such a good public-private partnership, wherein the Government with all other private stakeholders and farmer communities can launch the PPR Disease Control Programme. Today, India is aiming to achieve a clean India and a healthy India status. As Animal Husbandry is closely related to good health, our programme is helping our Prime Minister's mission of making India healthy. ICAR has several devoted institutions to carry out research and development pertaining to various animal health diseases and we have some participants from private sectors who are availing technology from these

institutions. With several international as well as national organizations participating in this conference, we are looking forward to a meaningful partnership at the national and international levels for the benefit of our farmers.

I am very happy that BAIF has taken the lead in this programme and I am very confident that with its extensive network across the country and a strong reputation for efficient delivery of service, we will be able to reach the needy across the country through this programme. I am very happy to see that there are many competitors who are compatible in this room - "compete as well as complement each other". As this disease affects the poor livestock owners, the social dimensions of the disease are even more serious than the economic dimensions of the disease. We really want to study the extent of damage caused by this disease and address it suitably.

We sincerely wish that this will not be a routine conference. We want proper action to be identified and hope that we can come up with a National Forum involving all the partners to initiate action and ICAR will be extremely happy to be a part of the forum and support whenever we can. Through this conference, we wish to send a message that it is our commitment to help all the small farmers, sheep and goat keepers and we are with them to address their problems. I hope the learned delegates of this conference will come up with a precise action plan at the end of the conference.

Vote of Thanks by Dr. Mamta Dhawan, Regional Manager, South Asia, GALVmed

We are thankful to Dr. Ayyappan, Dr. Honnappagol, the Government of India, ILRI, OIE, all our sponsors and other participants for their participation and support. We are looking forward to a fruitful outcome, to help our farmers.

KEYNOTE ADDRESS 1

Research Support for PPR Control

Dr. Philip Toye

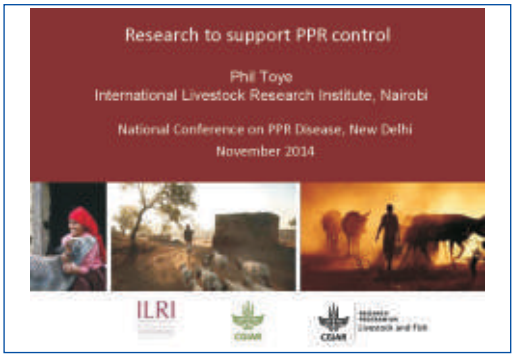
Principal Scientist and Theme Leader, ILRI, Nairobi, Kenya

While we need to understand the socio-economic impact of the disease, the epidemiological issues and technologies need to be improved. Firstly, we need to influence policy makers about the socio-economic importance of the disease. While managing the disease, the epidemiological data is very useful as there can be targetted interventions in specific disease-infested areas, instead of focussing on the entire population, which can maximize the impact while minimizing the cost and time. With regard to technology, thermostable vaccine can be very effective. Use of marker vaccine is also beneficial to distinguish the vaccinated animals from the infected animals.

Combination of vaccines can be more beneficial because of the cost, delivery and efficiency in covering animal health. Several vaccines of various diseases can be combined. However, the disadvantage is that the combined vaccine will be used where certain diseases are not even prevalent.

Use of modern diagnostic tools is also helpful to a great extent in controlling the disease. Penside tests are beneficial as they confirm the diagnosis. Rapid antibody tests are useful in studying the epidemiology and sero-monitoring. ILRI has had technical collaboration with various international organizations for development of thermostable vaccine as well as for developing penside test and DIVA vaccine.

The slides used during the Keynote address are presented below.



1

2

Research

- Socioeconomic
- Epidemiology
- Technology

3

Socio-economic

1. Need
   - inform policy
   - cost-benefit analysis
   - compare delivery paths

4

Socio-economic

2. Cost of disease
   - cost of extant disease
   - cost of disease risk
   - cost of successful control
3. Impeded by lack of epidemiological data

5

Epidemiology

Targetted intervention

-characteristics of SR populations
- high replacement, large
- not uniform exposure

-maximize impact, minimize cost and time

-focus on specific populations and time

6

Epidemiology

Targetted intervention

-disease transmission dynamics

-R_0 - immunity threshold

7

Epidemiology

Targetted intervention

-farmimg systems / geography

-host species / breeds

-viral strain virulence

-wildlife

-movement

8

Epidemiology

Targetted intervention

-action research

-experience - knowledge

9

Technology - Vaccines

1. Thermostability
   - several approaches
   - minimum performance standards
   - comparison

10

Technology - Vaccines

1. Thermostability
   - several approaches
   - minimum performance standards
   - comparison
2. DIVA – distinguishing infected from vaccinated

11

Technology - Vaccines

3. Combination vaccines
   - economies of scale
   - enhance uptake
   - single vial, single vector
   - SGP, CCPP, Bruc., parasites
   - disadvantages

12

Technology – Diagnostic assays

1. Pen-side test
   - outbreak reporting confirmation
   - rapid and remote – ICT
   - pathogen presence:
     - antigen
     - DNA

13

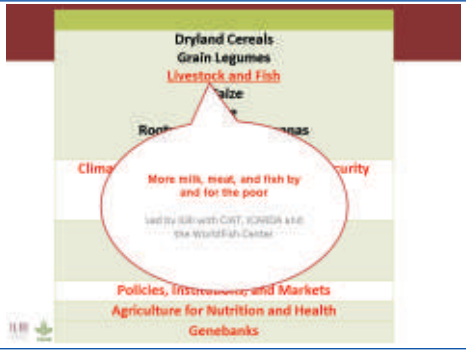
Technology – Diagnostic assays

1. Pen-side test
   - antibody- based test?
   - epidemiology / seromonitoring
   - expensive per sample
   - multi-sample 'rapid' test

14

ILRI Research Structure

15

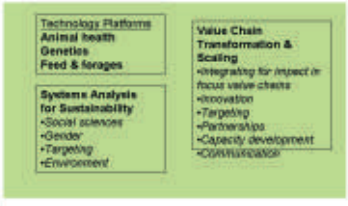


16

Working in 9 target value chains

17

L & F – research structure



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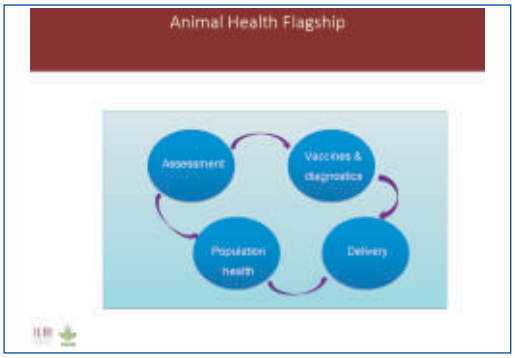

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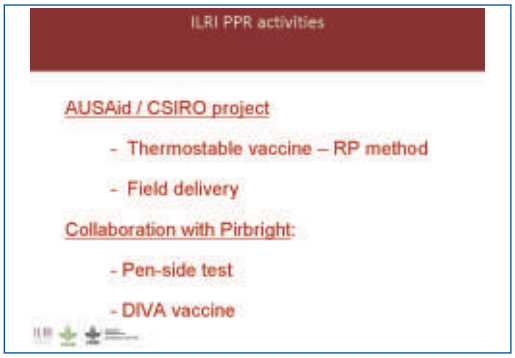

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KEYNOTE ADDRESS 2

The global strategy for control of PPR Disease

Joseph Domenech

Office International des Epizooties (OIE) (World Organisation for Animal Health), Paris

PPR was first detected in 1942 in Africa but today, it has spread across all the continents. With well-planned control measures, the disease has been declared free in the United States, Canada, South America, Europe and Australia and altogether 48 countries. In the fifth strategic plan of 2011-15 of OIE, improvement in animal health and welfare is one of the major agendas. The specific objective is food sufficiency which is ensured through healthy animals and effective veterinary services.

The good governance of veterinary service includes surveillance, detection, alertness and emergency response. This needs the support of good Government policy, surveillance, efficient laboratories and timely vaccination under Public-Private partnership. The first step in this direction is immediate notification and regular monitoring of the status. The information is collected through a regional network and a network of reference laboratories. These centres are also empowered in capacity building and training of member countries. FAO-OIE also has facilities for training of technical staff of member-countries in technical skills and managing reference laboratories. A PPR Global Eradication Strategy has also been evolved in 2014 with the objective of providing direct support to member countries from FAO-OIE. OIE Terrestrial Animal Health Code has also been developed in 2013.

There are three Reference Laboratories in the world:

1. CIRAD, Montpellier, France
2. Institute for Animal Health, Pirbright, UK
3. National Diagnostic Center for Exotic Animal Diseases, Qingdao, China

These laboratories have facilities for virus isolation, serological analysis and evaluation of vaccine quality, etc. The lessons learnt from Rinderpest Eradication Programme were long-term vision, commitment of the Government, International community support, support of the Regional Organisations and an International Organisational Platform to coordinate the programme. A similar strategy will be helpful even for controlling PPR disease. For global radication of the PPR, consultation process has been initiated and an international workshop was held in Rome to learn from the experiences of various countries including India. Based on this, a global programme for control of PPR has been prepared. In Africa, FAO has been involved in control of PPR disease and Bill and Melinda Gates Foundation through OIE, has been helpful in developing good quality vaccines and its distribution.

The PPR Control strategy includes:

1. Global PPR eradication
2. Strengthening Veterinary Services
3. Improving the prevention and control of other major diseases of livestock

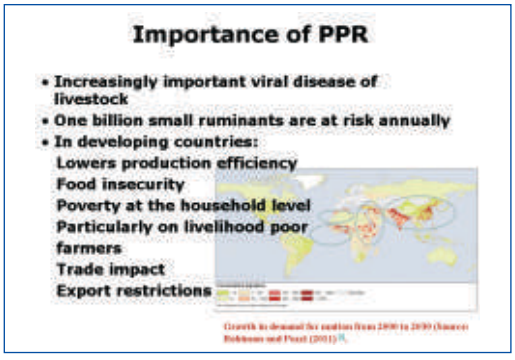
While controlling PPR, some information on surveillance of other diseases will be also taken for ensuring overall animal health. By 2020, 50% of the countries are expected to be free from the disease and by 2030, all the countries are expected to be free from PPR. For monitoring, we should have a national platform for coordinated activities in various regions. This should be followed by rigorous mass vaccination with priority for disease endemic areas through Ring vaccination. There should be an inter-disciplinary approach to blend good technology and social issues such as cost benefit analysis, motivation, etc. This will help in efficiently reaching small ruminant holders in remote areas. The issue of cost recovery should be considered well in advance and the programme will be very effective when farmers are made to share the cost of vaccination. Close observations and monitoring are needed at all stages to assess the extent of disease spread and damage, at the control stage through vaccination and post eradication stage.

Five important components of the programme will be diagnostic systems, surveillance, prevention and control, legal framework and involvement of stakeholders in the programme. There should be a close watch on the epidemiology of the disease with regard to infection of wildlife and role of other domestic species in hosting or spreading

the disease. Penside test may be adopted for diagnostic test. Vaccine delivery systems should be strengthened and development of thermostable PPR vaccine can help in solving many problems related to transportation and storage of vaccine. DIVA vaccine is expensive, but useful in the final stage of eradication.

Slides used during the address are presented below.

1



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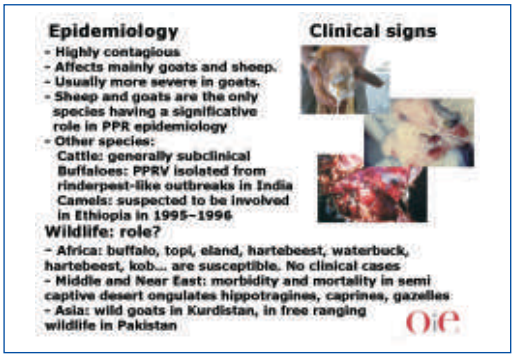

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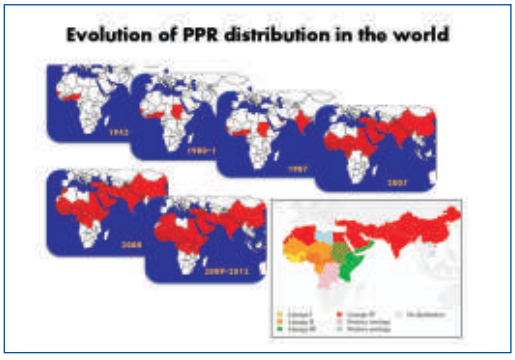

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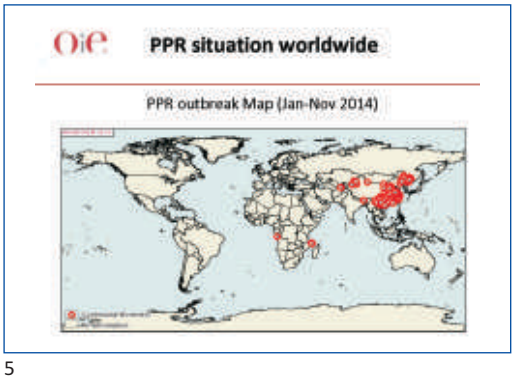

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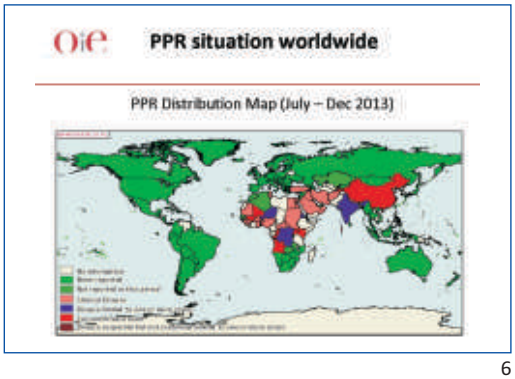

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PPR situation worldwide

Countries with an official OIE free-status from PPR (May 2014)

7

The key role of veterinary services

The « International Public Good » concept

Supporting Veterinary Services and control animal health programmes are national and international priorities

- Control of infectious diseases is beneficial to all countries and human generations
- Countries are interdependant. One country failing puts the others at risk
- Animal health systems are not commercial or agricultural private goods only. They are eligible to public funds

8

Fifth Strategic Plan 2011-2015

First, continuing to consolidate major objectives of the 4th Strategic Plan

Improve animal health and welfare worldwide

9

Improve animal health, veterinary public health, animal welfare, and *consolidate the animal's role worldwide*

OIE's 5th Strategic Plan 2011-2015

Reinforcing priority objectives

Food security

Healthy animals guarantee food security and food safety

Food safety

Veterinary Services must play a key role in **protecting consumers**

ensured through healthy animals and effective Veterinary Services

10

Good governance of Veterinary Services

For prevention and control of diseases, the credo is:

Surveillance, Detection, Alert, Emergency response

- **Official services, governance:**
  In charge of health policies, legislation, definition of control strategies, implementation of prevention and control programmes
- **Surveillance, laboratories, vaccination (QC)**
- **Public Private Partnership**
- **Rapid response (emergency preparedness)**
- **Coordination, harmonisation, international partnerships...**
- **Surveillance systems, information (transparency)**

11

WORLD ORGANISATION FOR ANIMAL HEALTH

Protecting animals, preserving our future

OIE tools to prevent and control animal diseases

Including tools developed with major partners

OIE activities are a public good

12

A. Horizontal tools and activities

Disease information

Reporting

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Disease information

Global Early Warning System (GLEWS)

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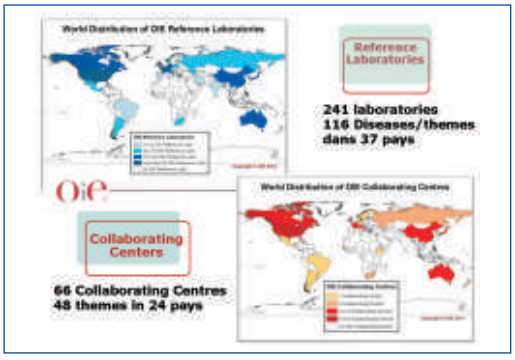

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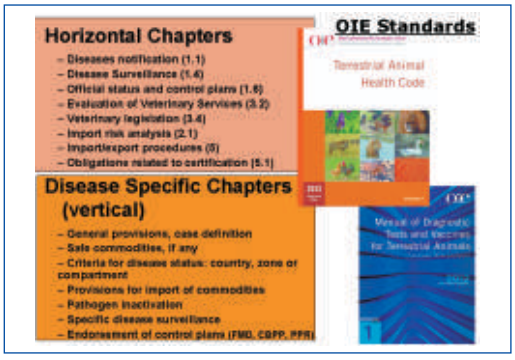

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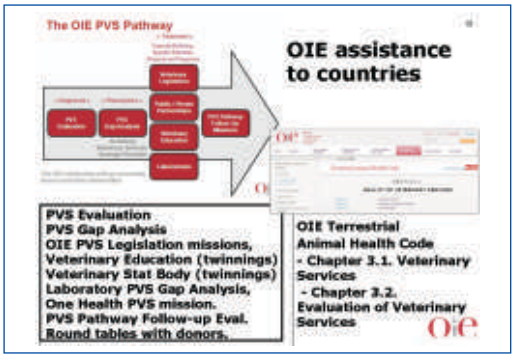

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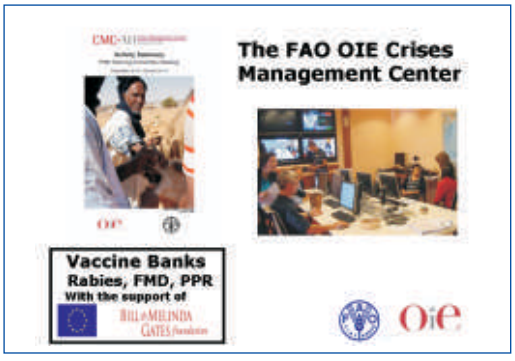

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GF-TADs

Global Strategies

PPR Global Control and Eradication Strategy End 2014

Direct support to member countries by FAO and OIE

The Annexes and supporting documents are available on the OIE and FAO websites

23

"One Health"

24

Publications www.oie.int
International Conferences

25

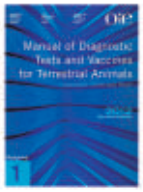
B. Specific tools and activities

- PPR disease information and reporting
- Relevant articles regarding PPR

In OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, 2012

Chapter 2.7.11
Peste des Petits Ruminants
(12 pages)

Summary
A. Introduction
B. Diagnostic techniques
C. Requirements for vaccines
References



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In OIE Terrestrial Animal Health Code, 2013

Chapter 14.8. Peste des Petits Ruminants

34 articles including :

- 5 articles on country status
- 19 articles on recommendations for importing commodities
- 1 on inactivation of the virus
- 7 articles on surveillance
- 1 article on endorsed official control programme

27

Centre de coopération internationale en recherche agronomique pour le développement
Dr Geneviève Libeau
Montpellier, FRANCE

cirad

Institute for Animal Health
Dr Michael Baron
Pirbright ,
UNITED KINGDOM

Pirbright

National Diagnostic Center for Exotic Animal Diseases, Dr Zhiliang Wang
Qingdao, China (People's Rep. of)

OIE and FAO Collaborating Centers in Epidemiology
Around 10 centres could work on PPR

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Available tools

Lab. diagnostic tests

- Virus isolation, IFI, Immunocapture
- Serological Analysis: c-Elisa, VNT
- Molecular biological techniques: Conventional RT-PCR, Quantitative RT-PCR, Sequencing

Vaccines

QC: compliance with OIE standards

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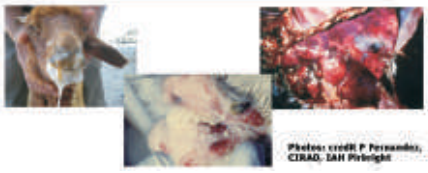
GF-TADs

GLOBAL STRATEGY FOR THE CONTROL AND ERADICATION OF PPR



Photos: credit P Fernandez, CIRAD, IAH Pirbright

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- **Resolution No.24 of the OIE 82nd General Assembly, in Paris, May 2014**
- **FAO 24th COAG, Oct 2014: establishment and implementation by FAO and OIE of a Global PPR Control and Eradication Programme**

Growing technical and political support for progressive control and eradication of major transboundary diseases

Technical issues that support a progressive PPR control and eradication strategy

One serotype. No carrier state after infection. No reservoir outside domestic small ruminants. Many of the tools required for progressive control are already available. Vaccine with life long immunity after a single dose. Diagnostic tests available

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The Global RP Eradication Program: lessons learnt

Long term vision
Government committment
International community support
Regional Organizations support
An International Organization platform to coordinate

32

Consultation process for the elaboration of the PPR Global Strategy

Similar to the preparation of the FMD Global Strategy

- Workshop with experts, national and regional authorities, policy-makers, development partners and private industry (Rome Oct 2014)
- Lessons learned from regions and key countries, including India
- The Global Framework for the Progressive Control of Transboundary Animal Diseases GF-TADs) provides the governance structure to prepare the Strategy
- Peer review of the strategy

Inputs from the OIE Scientific Commission and its Ad Hoc Group

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African Union
Interafrican Bureau
for Animal Resources

PAN AFRICAN PROGRAM FOR PROGRESSIVE CONTROL OF PESTE DES PETITS RUMINANTS (PPR) IN AFRICA

FAO Position paper on PPR Control, 2013
"FAO's approach for supporting livelihoods and building resilience through the progressive control of *PPR* and other small ruminant diseases"

Vaccine Standards and Pilot Approach to PPR Control in Africa (VSPA)

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Overall objective of the Global PPR Control and Eradication Strategy

A small ruminant sector contributing to global food security and nutrition, to human health and economic growth, particularly in developing countries and thereby alleviate poverty, increase income generation and improve the livelihoods of smallholder farmers and general human wellbeing.

Specific objectives

A progressive reduction of the incidence and spread and final eradication of PPR and, in non-infected countries, to maintain the officially free status

At the same time, through reinforced VS, to improve animal health globally by reducing the impact of other major infectious small ruminant diseases

Outcomes (Purpose)

Stakeholder and VS capacity to eradicate and prevent PPR and control other small ruminants diseases has been built

35

Three well-integrated components

The PPR Strategy will include three components which will address various issues:

- **Component 1. Global PPR eradication**
- **Component 2. Strengthening Veterinary Services**
- **Component 3. Improving the prevention and control of other major diseases of livestock**

Which means that the strategy will combine vertical disease specific and transversal (horizontal) approaches

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Expected results for PPR

- **By 2020, 50% of countries have reached Stage 2 and 50% Stages 3 or 4.**
- **By 2025, 50% have reached Stages 2 or 3 and 50% Stage 4.**
- **The ultimate expected result is that all regions and 100% of countries are free of PPR in 2030**
- **All countries which are already free from PPR at the beginning of the Global Control Strategy are maintaining this free status all along the Pathway period**

	2018	2020	2025	2030
'Stage 0'	25 %	0%	0%	0%
Stage 1	30 %	0%	0%	0%
Stage 2	30 %	50%	20%	0%
Stage 3	10 %	25 %	30%	0%
Stage 4	5 %	25 %	50 %	100%

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Monitoring and Evaluation tool

- **Objectives:**

To follow the implementation of the control strategy with a tool which describes the successive steps with the relevant activities and expected outcomes

- **Principles:**

Directly constructed from the global PPR control strategy.
Several steps from no epidemiology understanding to eradication
Combination of disease specific and transversal (Vet. Serv.) approaches.

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Post Vaccination Monitoring tool

Global Research and Expertise Network (PPR-GREN)

Objectives:

- to support the Global PPR Control Strategy implementation
- to offer technical advice and veterinary expertise to Member Countries
- exchange scientific data and biological materials

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The PPR Control and Eradication Strategy

The principles

- National, regional and global levels
- Risk based approaches
- Progressive phased approaches: Successive steps/phases to be defined, from endemic situation with no control activities to eradication of the virus
- Need to develop or strengthen specific and horizontal tools
- Interdisciplinary approaches
- Socio economic analysis and C/B

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Depends of:

- The available tools: surveillance systems, diagnostic laboratories, vaccines…
- The PPR epidemiological situation: endemic or free, production systems, socio economic systems
- The socio economic national and regional contexts, Veterinary Services, legislation, available tools, social context (attitudes, behavior, culture, politics and institutions), delivery systems…

Some difficulties

- Access to all areas
- Small ruminant holders

Cost recovery issue

Private or public good and combination

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Step-wise approach: successive stages

- Stage 1 → Assessment stage
- Stage 2 → Control stage
- Stage 3 → Eradication stage
  [Submission of the plans to the OIE]
- Stage 4 → Post eradication stage
  [Submission to the OIE for official free status]

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	STAGE 1 Assessment Stage	STAGE 2 Control Stage	STAGE 3 Eradication Stage	STAGE 4 Post-eradication Stage
FOCUS	To gain a better understanding on the presence of PPR	To control both PPR clinical disease and infection in a specific zone or productive system	To achieve PPR eradication throughout the national territory	To build evidence that there is no clinical disease nor virus circulation

Five elements to be considered:

- PPR diagnostic system
- PPR surveillance system
- PPR prevention and control system
- Legal framework for the prevention and control of PPR
- Stakeholders' involvement in the control of PPR

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Activities to be implemented (PPR)

- Activities relate to the five main elements (diagnostic, surveillance, prevention and control, legislation, stakeholders' involvement)
- Activities in a given Stage, are appropriate to mitigate the risk in accordance with the evidence provided in the preceding Stage.
- Activities and their impacts are measurable in each Stage

Capacity of VS considered as the 'Enabling environment' (compliance with OIE Standards).
Step-wise approach as well.

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Research and knowledge development

- Socio economics: impact of the disease, C/B of control programmes, possible incentives for control and eradication (export, combined actions)
- Strategies tailored according to farming systems: extensive, semi-intensive, small village backyard, trade or no trade
- Epidemiology knowledge: wildlife, role of other domestic species than small ruminants in PPR spread and maintenance
- Vaccine delivery systems: private services/public, Vets/CAHWs, cost recovery/public-private good
- Vaccines: thermostable, DIVA, combined vaccination (immunosuppression?)
- Diagnostic tests: penside tests

45

Governance mechanism (including monitoring)

Based on GF TADs principles: Global and Regional Steering Committees, global secretariat….

Regional PPR Roadmaps

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TECHNICAL SESSION 1: PPR Status, Economic Impact and On-going Research

Chairman: Prof. K.M.L. Pathak

Deputy Director General (Animal Sc.), ICAR, Government of India, New Delhi

1.1 Epidemiology of *Peste des Petits Ruminants* in India

V. Balamurugan, M.R. Gajendragad and H. Rahman

National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), Hebbal, Bengaluru 560 024, Karnataka

Peste des Petits Ruminants (PPR) is an acute, highly contagious, OIE-notified and economically important trans-boundary viral disease affecting sheep and goats. An analysis of the PPR outbreak reports/data available from 1987 to 2013 in the National Animal Diseases Referral Expert System (NADRES), NIVEDI, Bengaluru to assess the epidemiological status of PPR in India since the report of the first disease in 1987, revealed that PPR is among the top ten diseases reported in small ruminants and stands first among

the viral diseases with highest reported diseases. PPR is the major cause of mortality in small ruminants with 34% recorded in sheep and goats. PPR is enzootic in India as plenty of outbreaks have occurred in the past and are still occurring regularly throughout the country and round the year in all the seasons but is frequent during the lean period with wide geographical distribution. The peak season of outbreak for PPR has been from April to December.

Apart from sheep and goat, there is also other livestock which may carry this organism but they are not affected. Disease diagnosis is very important as very often, infected animals do not show all the symptoms. Some animals which are mildly infected may not exhibit all symptoms. Hence, proper examination is necessary to confirm the disease instead of looking only at major symptoms.

On analyses of PPR pathozones, wide variations in various states,with different levels of endemicity in the country was observed. Temporal analyses showed a gradual increase in outbreaks since 1995 with the highest peak recorded during 2005 and a declining trend after 2007. Some states like Andhra Pradesh and Karnataka have shown a decline in reported PPR outbreaks during the past five years due to implementation of strategic vaccination of sheep and goats and control measures under on-going national control programme on PPR. In Karnataka, the Government took up a very intensive PPR control programme on similar lines as Pulse Polio Vaccination Programme in 2003 and an intensified programme through follow up vaccination of unvaccinated animals over a period of five years, where mortality came down very significantly. In India, decreased numbers of outbreaks in recent years as well as changes in the disease patterns, severity and distribution might be due to the effectiveness of vaccines, timely vaccination of sheep and goats and circulation of a Single Lineage IV virus. The status of PPR in India was discussed during the deliberation.

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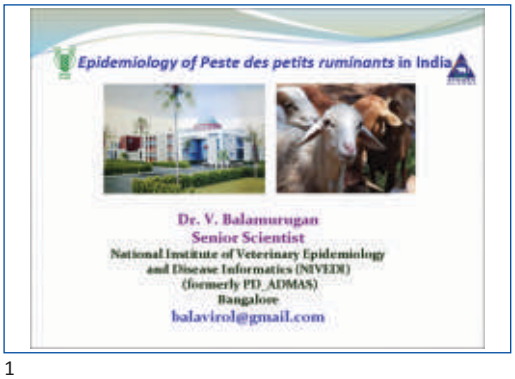

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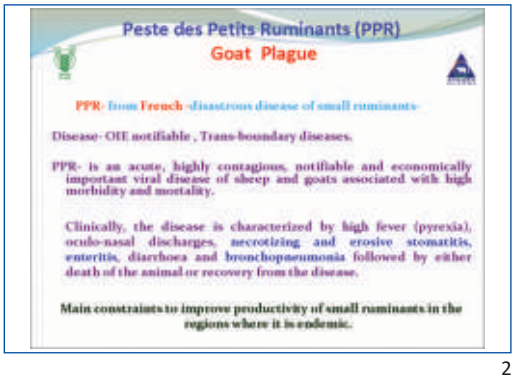

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Epidemiology vs Control of PPR

-need of strong support of diagnostic methods

-proper, timely vaccination of the susceptible population

-upon understanding the epidemiology of the disease are imperative.

3

PPR Epidemiology

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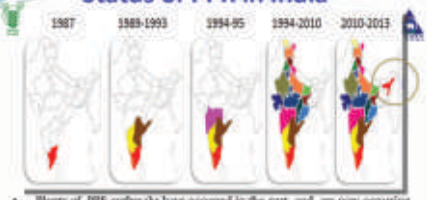
Status of PPR in India



- Plenty of PPR outbreaks have occurred in the past and are now occurring regularly throughout India.
- PPR is of increasing importance and likely to extend its geographic distribution especially in North Eastern states, as PPR outbreaks have been reported in Assam since 2011.
- Hence, it is extremely necessary to perform epidemiological surveys of this disease.

5

Sero-prevalence

Spatial distribution of districts covered in 2013-2014

2013-2014

320 serum samples
7 states (Meghalaya, Assam, Manipur, Nagaland, Arunachal Pradesh, Tripura and Mizoram) and
20 districts of North Eastern region in India (Balamurugan et al., 2014) 11.62% prevalence in Goats

6

Epidemiological Study

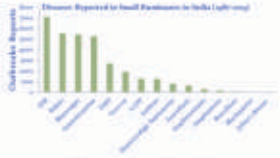
National Animal Disease Referral Expert System (NADRES)

- In NADRES software -forecasting, epi-reporting, database of PD_ADMAS, Bangalore. (NADRES is a computerized database of disease reports provided by different state AH departments and collaborating units of AICRP (All India Coordinated Research Project) on ADMAS).
- PPR outbreaks reports are available since 1995 from 17 states in 5 zones of the country.
- The majority of PPR outbreaks have been diagnosed based on clinical signs at field level by local veterinarians and compiled data at district level available with DAHF .
- The epidemiological data on PPR in India has been analysed based on the disease records (most of them based on clinical signs) available at NADRES database in PD_ADMAS. (NIVEDI).

7

Analysis of Outbreak reports (from 1991 to 2013) in NADRES

PPR features among the top ten diseases reported in small ruminants



PPR stands first and is the highest reported disease in sheep and goats

8

It is the major cause of mortality and accounts for 34 % of the mortalities reported in sheep and goats

Mortality due to Diseases in Small Ruminants in India (1987 - 2013)

PPR- 34%

BT-24%

Sheep and goat -pox-14 %

Enterotoxemia-12%

CCPP-5%

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Based on the frequency of Outbreaks reported Endemicity of PPR in India

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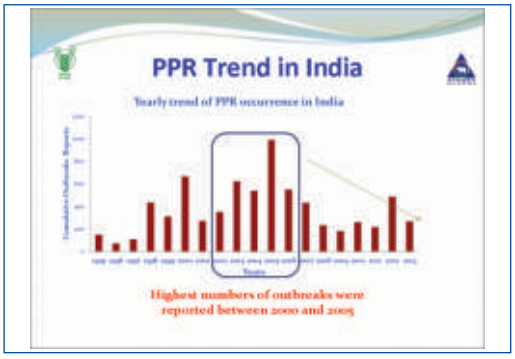

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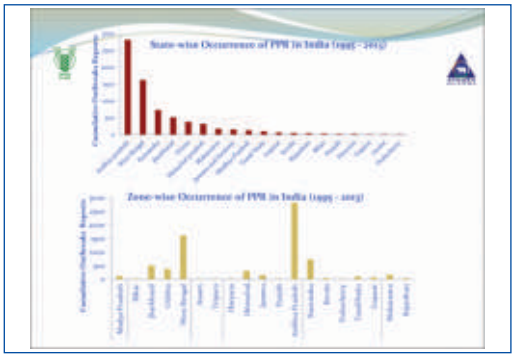

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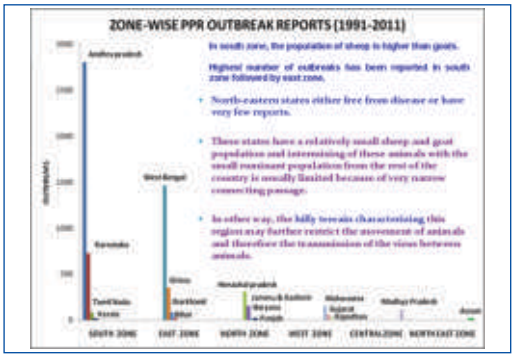

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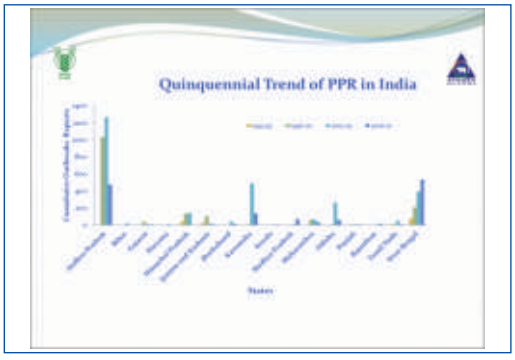

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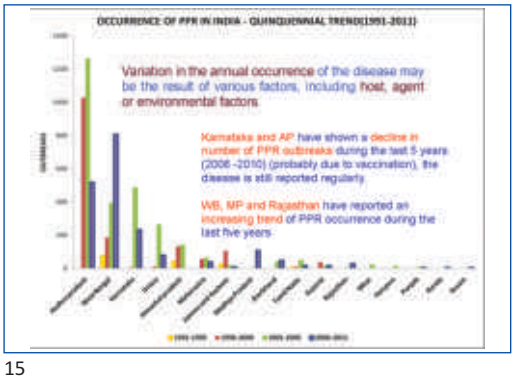

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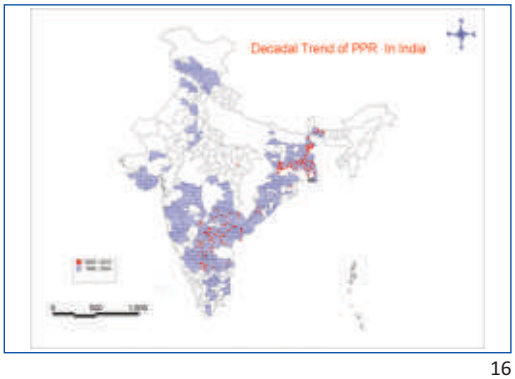

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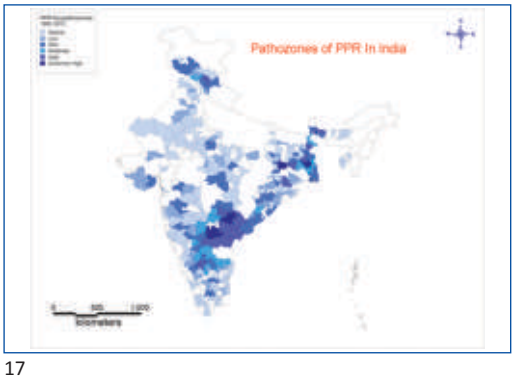

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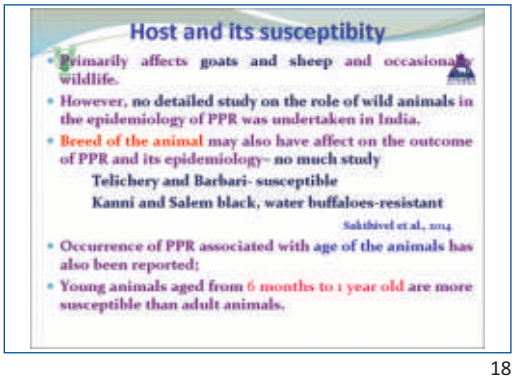

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Host and its susceptibility

More severe in young animals (6 months to 1 year old are more susceptible than adult animals)

- Goats more susceptible than sheep.
- Virus prefer goats, when both sheep and goats were in the flock- Northern India

But recent investigation in Karnataka, virus preferred sheep initially, which showed clinical signs, even though both species were there in the flock –Southern India

Cattle and Buffalo-in apparent infections-Camel-act as reservoir

- Cattle, camel and pigs seroconvert but do not transmit.
- Buffalo outbreaks reported (Govindarajan et al., 2007)
- Detection of PPRV in the Lion tissues (Balamurugan et al., 2012)

No Carrier Status ?

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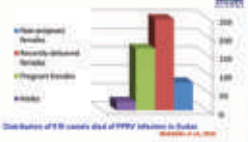
Carcasses of camels died of PPRV infection scattered in northern Butana, Sudan



In India, we have screened around 866 serum samples from Camels in various districts of Rajasthan- by C-ELISA

None of the samples showed positive for PPRV antibodies i.e., not more than 40% PI

However, 25 to 40 % PI- 298 samples – this may be doubtful samples

20

Species Susceptibility

- Increased number of outbreaks have been reported in goats than in sheep in the different zones of the country, except in south zone where the number of outbreaks were greater in sheep.
- These findings may be correlated with variations in the sheep and goat husbandry practices within different geographic regions.
- The ratio of goats to sheep and the population intensity vary greatly under different agro-climatic conditions.
- PPR affects goats more than sheep and the population of goats to sheep is almost 2:1 in India.

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Species wise outbreaks in India

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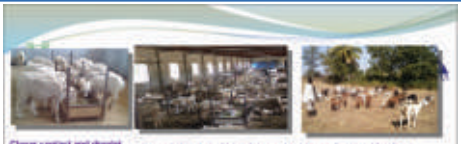

Close contact and droplet

Aerosol, Contact with ocular, nasal, oral secretions and feedes

No known carrier State

Transmission

No involvement of vector

Goats in Bhandy (Local Market)

Nomad –migration of infected animals

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Transmission

- Labile at out-side of the environment.
- PPRV-Sensitive at 60°C for 1h; Stable at pH 4.0 to 10.0; Killed by alcohol, ether and detergents.
- Excretion or shedding of the virus occurs through secretion of the affected animals.
- Natural transmission- possible in field among sheep. Goats. Cattle, buffaloes, camels .
- Sero-epidemiology- it is necessary to include cattle and other ruminants

24

Seasonal Distribution

- Climatic factors favourable for survival and spread of the virus may also contribute to the seasonal distribution of PPR outbreaks.
- Animal husbandry practices, agro climatic conditions, and geographical locations may have some effect on the seasonal distribution of the disease.
- This seasonal occurrence of the disease was correlated with the animal movements and climatic factors in India.
- Most of the investigators have linked the PPR outbreak with introduction of new animals to the flocks.
- Based on monthly data on PPR outbreaks, PPR has been found to occur throughout the year but was encountered most frequently during the lean period either in wet season/rainy season or during the cold dry season (December to February).

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Seasonal Distribution

It occurs any time during the year

Wet seasons (April-Sep/Oct)

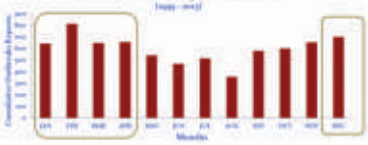
Cold dry seasons (Dec, Jan and Feb) with inclement dry cold weather coupled with poor nutrition,

- March and June – more outbreaks
- Animal movement (migratory pattern)
- Lean period- hot dry summer period/season
- Climate factors- start of rainy season (July and aug/sep)
- peak in dry season than rainy season
- Other disease- ORF, BT, etc.,

26

Month-wise outbreaks of PPR- 1995-2011

- Animal husbandry practices
- Agro climatic conditions
- Geographical locations
  - It occurs any time during the year
  - Increases incidence -Cold dry seasons (Dec-Feb) or Lean period with inclement weather coupled with poor nutrition.



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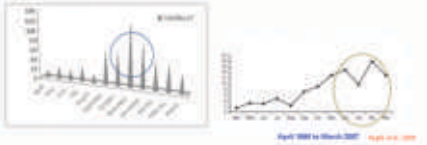
Average monthly peste des petits ruminants outbreaks in Karnataka, April 2003 to March 2013



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Sero prevalence

Antibody in the host- sub clinical/inapparent /non lethal infection in animals .

PPRV antibody in cattle- role in RP eradication

Maternal antibody-

lamb-3-5 to 4 months
Kids 4 to 5 months (Balamurugan et al., 2012)

Based on the suspected samples -India

- 55%-in total -sheep (56.3%) and Goat (53.4%)- 1997-2014 states (Singh et al., 2014)
- 43.56%-in total -sheep (41%) and Goat (46.1%)- 2003-2009 states (Balamurugan et al., 2011)
- 32.47 % in total – goats (38/117) -2013 states in Assam (Balamurugan et al., 2015)

29

Based on the random samples -India

South India –

41.38% sheep (1,492) and 34.91% goat (2,068) (Rajavelu et al., 2009)

4.48 % bovine (cattle and Buffaloes) (Balamurugan et al., 2012).

India- Prevalence of 21.82 % with 11.07 % in cattle, 16.20 % in buffaloes, 45.66 % in sheep and 38.54 % in goats in 32 districts in five states (Andhra Pradesh, Gujarat, Jammu and Kashmir, Maharashtra and Rajasthan) of India. (Balamurugan et al., 2012)

NE India

Prevalence of 1 .3% in goats on screening of 150 samples from three states (Meghalaya, Assam and Manipur- district covered is 12) (Singh et al., 2004)

Prevalence of 11.62% in goats on screening of 320 samples from SEVEN states 7 states (Meghalaya, Assam, Manipur, Nagaland, Arunachal Pradesh, Tripura and Mizoram-20 Districts- 2013-14 (Balamurugan et al., 2014)

30

Molecular Epidemiology of PPRV in India

Endemic in Africa, Middle east and Parts of Asia

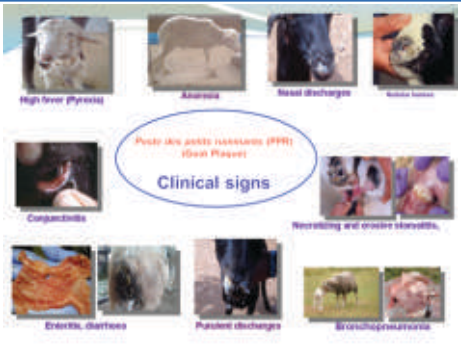
- Lineage I –Nigeria , Cameroon
- Lineage II – West Africa- ICV, Senegal
- Lineage III – Eastern Africa (Ethiopia), A and Sudan
- Lineage IV- Middle East, Arabia and Indian Sub continent

- Lineage IV is restricted in Asia whereas the other three are prevalent in Africa (Shaila et al., 1996; Dhar et al., 2002)

Now Africa also reported- Morocco, Sudan, South East Gabon

All Indian vaccine strains and field isolates- lineage IV –prevalence except one report of Lineage III.

31



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Changing pattern of Disease-

Prominent clinical signs are

- Respiratory distress – Cough, dyspnoea and sneezing

- Nasal discharges-are dominants signs in the flocks
- Some cases – Diarrhea
- Mortality is less than 5 or 6 % -only in young animals
- One or few cases-Necrosis and ulceration of mucous mem in young animals

- Recovery rate more
  - Vaccination programme
  - Timely vaccination
  - Prevalence of single type of virus
  - Effectiveness of available vaccine

33

PPR affected sheep

34

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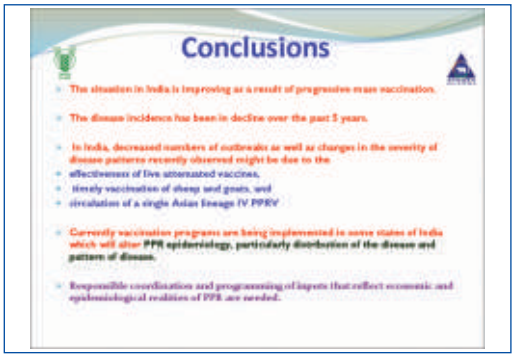

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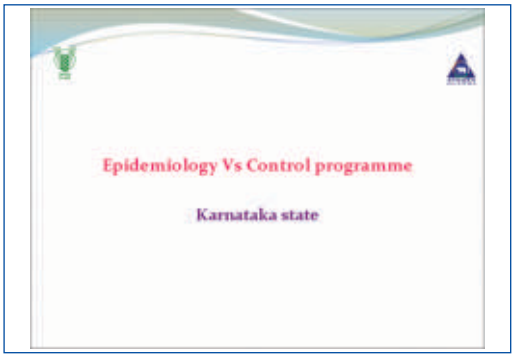

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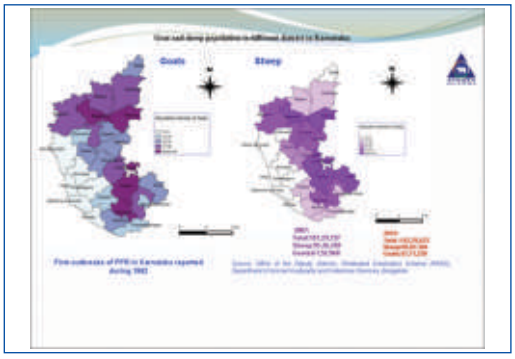

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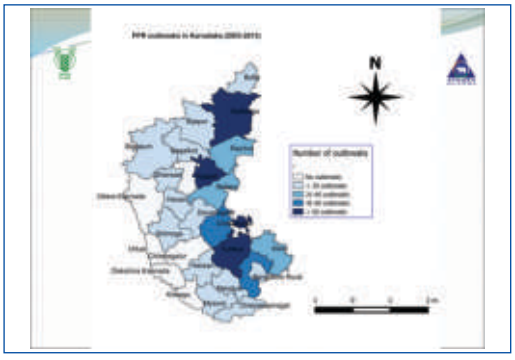

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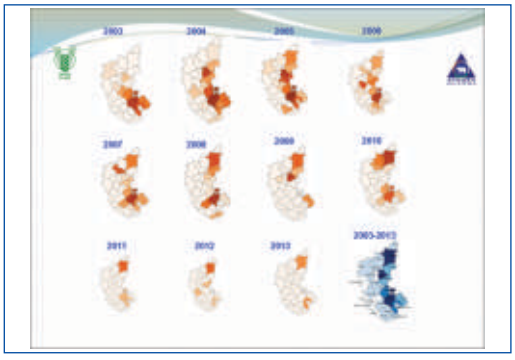

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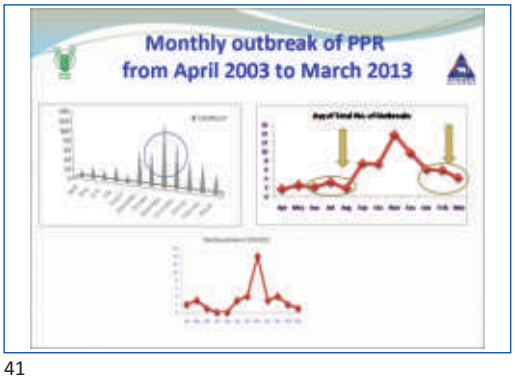

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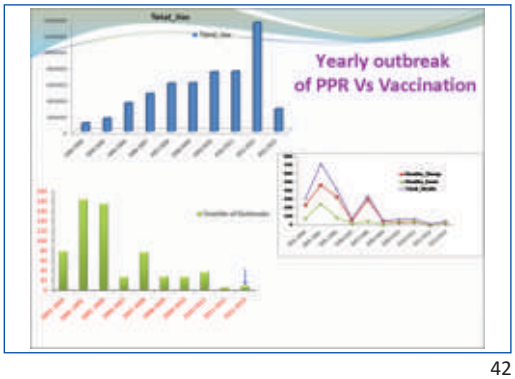

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PPR Disease Profile in the Karnataka State before implementing the programme

Out breaks are more frequent during winter seasons and all the districts in the state except coastal area are affected.

S No	Financial Year	Vaccination (Lakhs)	Outbreaks	Attacks	Deaths
1	2006-07	46	27	683	66
2	2007-08	59	77	1524	338
3	2008-09	60	28	326	46
4	2009-10	73	28	456	66
5	2010-11	74	36	612	71

43

Important features of vaccination programme:

- Sheep & goat population of the State approx. 140 lakhs in all the villages of the State are covered on pulse polio model.
- 250 vaccination teams have been formed and each vaccination team comprising of one Vety. Officer, 5 vaccinators (Para Vets) and one assistant (D group).
- The entire programme is planned for 24 working days (in a month) on team and route approach.
- Proper care has been taken for cold chain maintenance and in time supply of vaccine, needles, syringes and other materials.
- Compulsory disease reporting and Sero monitoring taken up.

44

Achievement under the NCP-PPR (2011-12) for the first phase

- The Vaccination Programme conducted for one month, from 6th June to 5th July , 2011-12 in

Pulse polio model

Year	Vaccination (in lakhs)
2011-12	130

45

Sero monitoring

- Pre and post vaccination serum samples collected to evaluate the efficacy of PPR vaccination.
- In the 1st phase of vaccination about 8715 samples were screened by IAH&VB Hebbal, Bangalore.

Result of samples:

	Pre-vaccination	Post-vaccination
+ve samples	2325	2940
- Ve samples	1655	1795

46

Impact of the 1st phase of vaccination

Severity of outbreaks after the first phase of vaccination very low due to intensive vaccination on pulse polio model where the vaccination coverage was more than 90%.

Year	Vaccination (in lakhs)	Outbreaks	Attacks	Deaths
2011-12	130	3	42	8

47

Second phase of PPR vaccination

- 1st phase of PPR vaccination was taken up in the month of June 2011.
- 2nd phase of PPR vaccination was suppose to be taken up 6 months after the 1st phase.
- But is has been delayed for 2 years due to delay in timely release of funds.

48

Impact of delay in implementing the 2nd phase of PPR vaccination

- Outbreaks have been occurred due to delay in taking up 2nd phase of vaccination. Therefore, ring vaccinations were carried out where the outbreaks have occurred.
- In the State level monitoring committee decided to take up 100% of vaccination in the pulse polio model as it was in 1st phase in the 2nd phase also and it has been conduct from May 15th to June 14th of 2013.

49

Progress of the 2nd phase of vaccination

Target in lakhs	Achievement in lakhs (18/12/06/2013)	Percentage
10424741	9175736	88%

Vaccination programme started from 15/05/2013 and end on 30/06/2013.

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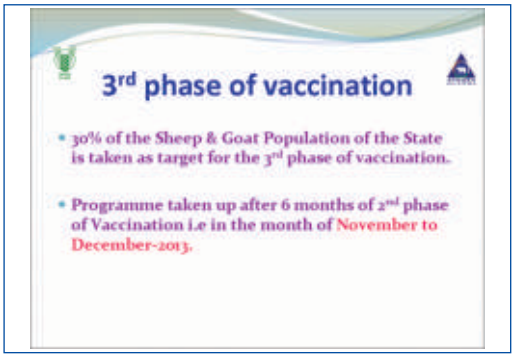

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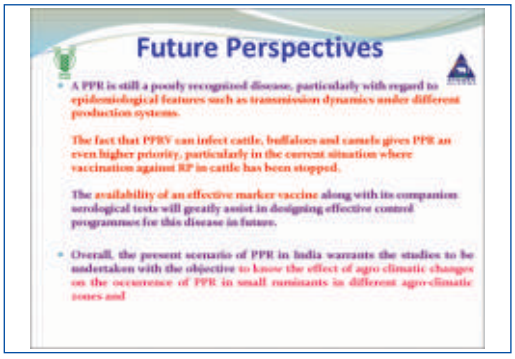

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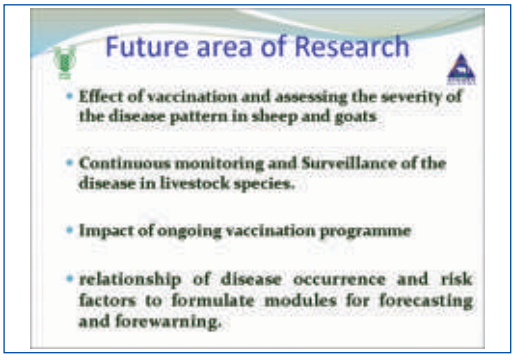

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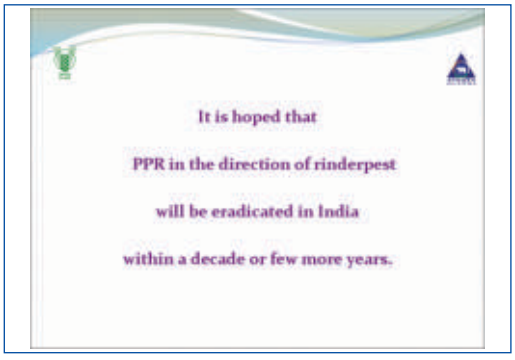

54

1.2 Challenges of PPR Control in Rajasthan

Rajesh K. Mann and Ravi Israni

Department of Animal Husbandry, Government of Rajasthan

As per 19th livestock census, 2012, Rajasthan with 21.66 million goats, accounts for 16% of the national goat population while ranking first in goat population, sixth in meat production with 0.056 million tons of meat and first in goat milk production (1.641 milliontons) among all the states of India. Rajasthan ranks third in sheep population with 9.076 million sheep, sixth in meat production with 0.020 million tons of meat and first in wool production in the country. Approximately, 276 million families are engaged in sheep and goat rearing. Small ruminant rearing is the most preferred occupation for weaker sections of the society while it is a gender-based livelihood activity within a family. For women-headed families and landless families, it is a major source of livelihood. However, the high mortality in sheep and goats due to outbreak of PPR has been one of the biggest challenges for the small ruminant families. The major difficulties faced in Rajasthan were extensive migration of sheep which makes vaccination as well as reporting of disease outbreak difficult.

In 2011-12 and 2013-14, PPR outbreaks were noticed in Udaipur (1 outbreak in goat, mortality 1.3%), Baran (1 in sheep, mortality 1.3%), Kota (1 each in sheep and goat, mortality 3.42% in sheep and 3.2% in goat), Bundi (1 in goat, mortality 3.13%), Sawai Madhopur (1 in goat, mortality 0.66%), Pali (1 in goat and sheep each, total mortality 2.46%), Sikar (2 in goat, mortality 0.03%), Bhilwara (1 in goat, mortality 0%) and Nagaur (3 in sheep and goat each, mortality 5.33% for sheep and 0.81% for goat). There was no outbreak of PPR in the state during 2012-13. During 2013-14, PPR outbreaks were reported in Jaisalmer (1 in goat, mortality 0%) and Dholpur (1 in sheep, mortality 0.20%). Preventive vaccination undertaken by the State Animal Husbandry Department was 408182, carried out before winter as well as during winter, at a nominal charge of Rs. 2 per cattle head. As the above vaccination programme has been very effective in controlling the disease, mass vaccination followed by repeat vaccination to cover the unvaccinated animals will be taken up in the future.

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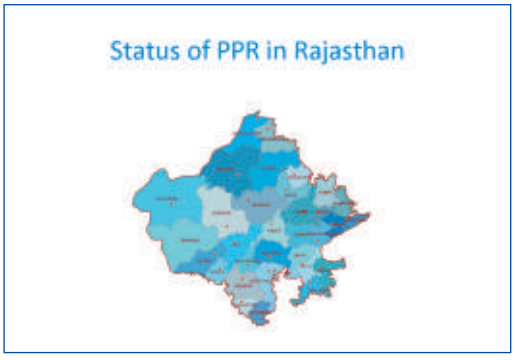

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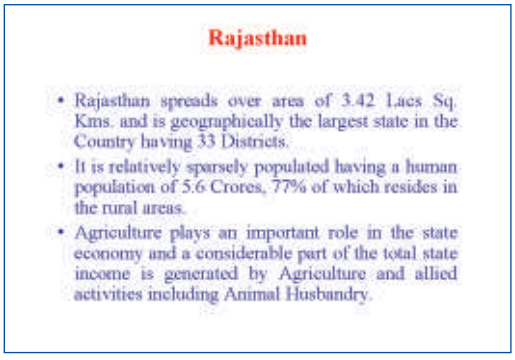

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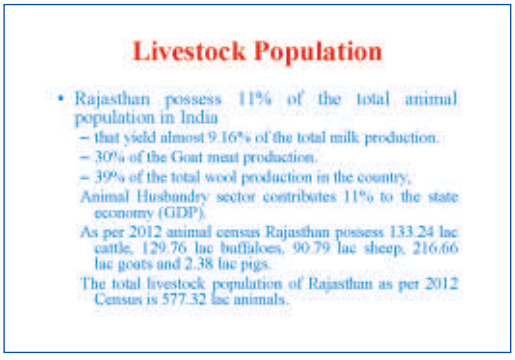

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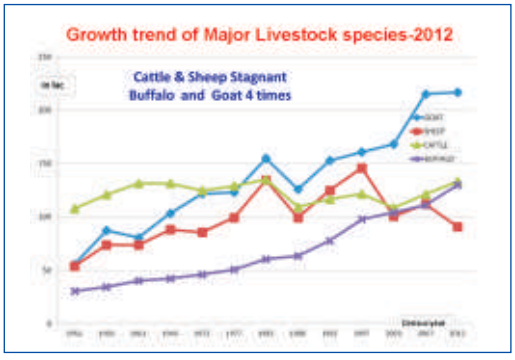

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LIVESTOCK PRODUCTION (TREND)

Year	Milk Production (Thousand tonnes)	Meat Production (Thousand tonnes)	Egg (Millions)	Wool Production (Lac kg)
1995-96	5449	32	436	174
2000- 01	7455	51	572	194
2005- 06	8581	68	710	153
2009-10	12936	92	671	125
2010-11	13900	104	670	123
2012-13	13946	152	1034	140
2013-14	14574	175	1190	150

5

PPR-CP PROPOSALS SENT TO GOI

- Action plan submitted under 100% CSS for Eradication of PPR disease
- Project submitted to GOI on 15.7.2014
- Revised Project under process with an approximate cost of about 8-10 crores
- Revised project will be submitted by the end of December 2014

6

Veterinary Institutes

- To cover the huge area of the State and a large livestock population, Department of Animal Husbandry has established a chain of Veterinary Institutes (5018) throughout the State.
- There are 34 Veterinary Polyclinics.
- 775 Ist Grade Veterinary Hospitals.
- 1518 Veterinary Hospitals.
- 198 Veterinary Dispensaries.
- 2171 Sub Centres.
- 34 District Mobile Units
- 288 Tehsil Mobile Units.
- Along with this department has One State Disease Diagnostic Centre, 6 Regional Disease Diagnostic Centre and 27 Districts Disease Diagnostic Laboratories.

7

Peste des petits ruminants (PPR)

- **The disease is endemic in Rajasthan and causes large economic losses each year due to the high rates of mortality and morbidity in infected sheep and goats.**

8

SHEEP MIGRATION

Permanent : Approx. 15-20 lacs

- Other States
  (MP, UP,Haryana, Punjab, Gujarat)
  (Natural bindings) ⇕ (Bajra, Water lodging, Big grass)
  South East Rajasthan (Pathari area)
  (Kota, Bundi, Sawai Madhopur, Baran, Jhalawar, Chittorgarh, Bhilwara, Bharatpur, Alwar, Dholpur)
- Period : July to October (Approx. 4 months)
  (variations due to monsoon)
- Never returns to native places (Jodhpur, Nagaur, Pali, Sirohi, Jalore, Barmer, Ajmer).

Temporary : Approx. 2-2.5 lacs

- Within the State, particularly from western districts.
  (Inter district)
- Period : October to July
  (Post Deepawali till monsoon, after that back to native places)
  (variations due to monsoon)

9

No. of PPR outbreaks in state

Year	No. of outbreaks	No. of Animals affected	No. of Animals Died	No. of Animals vaccinated against PPR (In Lac)
2011-12	14	1738	259	1.97
2012-13	Nil	Nil	Nil	4.11
2013-14	3	1778	24	4.32
2014-15	Nil	Nil	Nil	3.39

10

Constraints and Problems

- Large geographical area with different agro-climatic and socio-economic regions.
- Large population of susceptible livestock population.
- Shortage of sufficient technical manpower in veterinary institute specially in western and southern districts of the State.
- High Temperature during summer.
- Recurrent droughts and famine-Migration.
- Illegal migration through International borders.
- Migration of large population specially sheep to other states.

11

Expected Outcome of PPR-CP

- Reduction in the production losses.
- Reduction in the abortion and losses due to breeding capacity.
- Enhancement of national and international small ruminant trade.
- Wool, leather and meat production will increase.

12

1.3 Estimation of economic loss due to PPR in sheep and goats: An incremental prevalence based analysis

G. Govindaraj, V. Balamurugan and H. Rahman
National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), Hebbal, Bengaluru 560 024, Karnataka

PPR is a highly contagious viral disease prevalent in small ruminants and resulting in huge losses to various stakeholders. In India, PPR is enzootic with many outbreaks reported in different geographical regions. However, due to lack of reliable data on actual field outbreaks occurring in various species, age groups, regions, etc. the assessment of economic loss based on secondary information of outbreak, attack and death is less valid for policy making. Hence, an attempt has been made to estimate economic losses based on the incremental prevalence, morbidity levels, mortality levels etc. derived from literature, discussion with experts and scientific facts. Different mathematical models have been used to assess the loss due to mortality in young and adult sheep/goat, body weight loss in young and adult sheep, increased inter lambing/kidding period, increased abortion, cost of high feeding and rearing inputs in young and adult sheep/goat, etc. A sensitivity analysis for change in the incremental prevalence levels was also attempted to assess the lower, middle and upper bound levels of losses due to PPR in the country and in selected states. The details of the loss estimation method attempted and the results will be discussed during the sessions.

Generally, when the disease spreads, it infects about 5-10% of the population in the district. This has been the assumption while calculating the loss at the national level. In case of sheep, the estimated loss at 5% infection is around Rs. 237 crores, Rs. 470 crores at 10% and Rs. 700 crores at 15% infection. With regard to goat population, at 5% infection, the estimated loss is around Rs. 567 crores and Rs. 1135 crores at 10% and Rs. 1700 crores at 15%. Further study is required to correctly document the loss and calculate economic and social losses incurred by the community.

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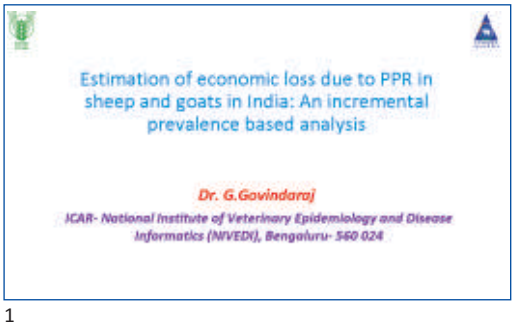

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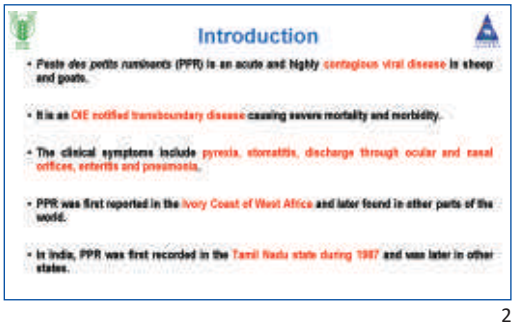

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- Despite the significance of the disease in India, the reliable loss estimates are still lacking.
- Thombare and Sinha (2009) studied the economic implications of PPR in Pune district of Maharashtra state (high outbreak district).
- Singh and Prasad (2009) reported average annual loss of Rs.91.42 lakhs due to PPR in goats (based on reported time series data on outbreak, attack and death).
- Singh *et al* 2014- the loss due to PPR estimated was Rs.167.83 lakhs.
- Based on 2007 population census, morbidity and mortality rates, prevalence rates derived from few primary survey studies carried at different points of time viz., Thombare and Sinha (2009), Mahajan *et al* (2013). The annual loss estimated by Singh *et al* 2014 for PPR disease based on the above criteria was 9895.12 crores (Rs.6477.48 crores in goat and 3417.64 crores in sheep).

3

Need for appropriate loss estimates

- Any generalized annual loss estimation should consider the incremental prevalence of the disease in a year and not based on the point estimates of prevalence.

Particulars	Prevalence (%)		
	Thombare and Sinha	Mahajan et al	Tiwari
Year	2008	2013	2004
Sheep	53.8	66.7	35.80
Goat	53.2	66.7	35.90

- The studies on prevalence of antibodies (Mahajan et al 2013; Tiwari 2004) is not necessarily mean overt manifestation of the disease in all the animals in a year and thus production losses and moreover, the antibodies level may depend on the virus load, breed, immunity levels, vaccination etc. and hence prevalence percentages from these studies cannot be used for loss projections. In extreme case it can be used for if the outbreak occurs in all parts of India.
- Hence, the incidence levels or the incremental prevalence from the antibody studies may be appropriate for loss projections.

4

Approach

- The use of incremental prevalence (ΔP_i) will be appropriate in place of prevalence per se for estimating the annual economic losses

ΔP_i - Change in prevalence levels

- The incremental prevalence or incidence considered for estimating the losses was 5%, 10% and 15% (Aleese *et al* 2013, Singh *et al* 2004 and Balamurugan *et al* 2011)

Particulars	Prevalence (%)		
	Singh et al	Balamurugan et al	Difference (%)
Year	2008-2009	2001-2009	
Sheep	36.1	41.8	5
Goat	32.4	44.0	12

Particulars	Rate in goats (%)
Aleese et al, 2013	
District A	15.3
District B	5.1
Pooled	9.7

- This levels might be appropriate till a large scale primary survey is carried out across different regions of the country with appropriate sampling methods and techniques to estimate the annual loss due to PPR

5

Methodology

Data Sources

- The loss due to PPR in sheep and goat was estimated based on the data derived from secondary sources, expert opinion, field investigation results and past reviews.

6

Table 1: Parameters considered for assessing the loss due to PPR in sheep and goats

Label identity	Parameters	Sheep	Goats	Data source
A	Population	Actuals	Actuals	2012 livestock census
A1	Adults (%)	Actuals	Actuals	2012 livestock census
A2	Young (%)	Actuals	Actuals	2012 livestock census
B	Incremental PPR prevalence (%percent/year)	5/10/15	5/10/15	Aleese et al 2013, Singh et al 2004 and Balamurugan et al 2011
C	Adult Mortality (%)	10	10	Expert opinion
D	Adult Morbidity (%)	5	5	Expert opinion
E	Lamb/kid Mortality (%)	20	20	Expert opinion
F	Lamb/kid Morbidity (%)	20	20	Expert opinion

7

Cont..

Label identity	Parameters	Sheep	Goats	Data source
G	Average weight of Adult (kg)	20	20	Probable values
H	Average weight of Young (kg)	10	10	Probable values
I	Price of live weight animal (Rupees/kg)	300	300	Prevailing market price in Karnataka during 2013
J	Price of the one young animal (Rupees)	3000	3000/-	
K	Price of the one adult animal (Rupees/Kg)	Rs 6000/-	Rs 6000/-	
L	Reduction in body weight due to morbidity (%)	10	10	Obtained during outbreak investigation in Karnataka state
M	Average number of Lambs/kidding or kidding per animal	1	2	Expert opinion
N	Average birth weight of lamb/kid (Kg)	2.5	2	Expert opinion
O	Proportion of female animals in abortion (%)	2	2	Expert opinion
P	Inter-kidding or Lambing period (months)	12	10	Expert opinion
Q	Delay in next conception (months)	0	0	Expert opinion

8

Cont...

Label identity	Parameters	Sheep	Goats	Data source
R	Cost of flock incurred (Rupees per animal/month)	120	120	Obtained during outbreak investigation in Karnataka state
S	Additional period of feeding the animals (months)	3	3	Expert opinion
T	Average treatment cost of the animals (Rupees)	120	120	10% increment of Aleese et al 2013 observation
U	Increased cost of Management including labour (Rupees)	60	60	Obtained during outbreak investigation in Karnataka state
V	Other miscellaneous indirect cost (Rupees)	60	60	Obtained during outbreak investigation in Karnataka state

9

Models

1) Mortality loss in sheep

I. $M_{AS} = A \times A1 \times B \times C \times G \times I$

Where,

M_{AS}=Loss due to mortality in adult sheep (Rs.)

A = Population of sheep

A1= Adult population (%)

B = Incremental PPR prevalence (%)

C = Adult mortality (%)

G = Average weight of adult (Kg)

I = Price of live weight animal (Rs./Kg)

II. $M_{YS} = A \times A2 \times B \times E \times H \times I$

Where,

M_{YS}= Loss due to mortality in young sheep (Rs.)

A = Population of sheep

A2 = Young animal population (%)

B = Incremental PPR prevalence (%)

E = Young animal mortality (%)

H = Average weight of young one (Kg)

I = Price of live weight animal (Rs./Kg)

10

2) Body weight loss in sheep

a) loss due to reduction in body weight in sheep

I. $BW_{AS} = A \times A1 \times B \times D \times G \times L \times I$

Where,

BW_{AS}= Loss due to body weight in adult sheep (Rs.)

A = Population of sheep

A1 = Adult population (%)

B = Incremental PPR prevalence (%)

D = Adult morbidity (%)

G = Average weight of adult (Kg)

L = Reduction in body weight due to morbidity (%)

I = Price of live weight animal (Rs./Kg)

II. $BW_{YS} = A \times A2 \times B \times F \times H \times L \times I$

Where,

BW_{YS}= Loss due to Body weight in young sheep (Rs.)

A =Population of sheep

A2= Young animal population (%)

B = Incremental PPR prevalence (%)

F = Young animal morbidity (%)

H = Average weight of young animal (Kg)

L =Reduction in body weight due to morbidity (%)

I = Price of live weight animal (Rs./Kg)

11

b) Live weight loss due to increased inter-lambing period

$BW_{IP} = A \times A1 \times B \times 0.5 \times [(12/P)-(12/P+Q)] \times M \times N \times I$

(Singh and Prasad 2009)

BW_{IP} = Cost of Body weight loss due to increased inter lambing period in adult female sheep (Rs.)

A = Population of sheep

A1 = Adult population (%)

B = Incremental PPR prevalence (%)

P = Inter-lambing period (months)

Q = Delay in next conception (months)

M = Average number of lamb/lambing

N = Average birth weight of lamb

I = Price of live weight animal (Rs./Kg)

c) Live weight loss due to increased Abortion

$BW_{AB} = A \times A1 \times B \times 0.5 \times O \times N \times I$

BW_{AB}= Cost of Body weight loss due to increased abortions in female sheep (Rs.)

A =Population of sheep

A1= Adult population (%)

B = Incremental PPR prevalence (%)

O = Proportion of female animals in abortion in percentage or increased abortion rate in percentage

N = Average birth weight of lamb (kg)

I = Price of live weight animal (Rs./Kg)

12

3) Other Associated loss

a) Cost of high feeding and rearing inputs

I. Adults sheep

$FRI_{AS} = A \times A1 \times B \times D \times R \times S$

Where,

FRI_{AS}= Cost of high feeding and rearing inputs in adult sheep (Rs.)

A = Population of sheep

A1= Adult population (%)

B = Incremental PPR prevalence (%)

D = Adult Morbidity (%)

R = Price of feeding per animal/month in that particular period

S = Additional Period of feeding the animals in month

II. Young sheep

$FRI_{YS} = A \times A2 \times B \times F \times R \times S$

Where,

FRI_{YS}= Cost of high feeding and rearing inputs in Young sheep (Rs.)

A = Population of sheep

A2= Adult population (%)

B = Incremental PPR prevalence (%)

F = Young animal morbidity (%)

R = Feed cost incurred per animal/month(Rs.)

S = Additional Period of feeding (months)

13

3) Other Associated loss

b) Miscellaneous loss

I. Adults sheep

$MIs_{AS} = A \times A1 \times B \times D \times (T+U+V)$

Where,

MIs_{AS}= Cost of miscellaneous loss in Adult sheep (Rs.)

A=Population of sheep

A1= Adult population (%)

B= Incremental PPR prevalence (%)

D= Adult morbidity (%)

T= Treatment cost of the animals (Rs.)

U= Increased cost of management including labour (Rs.)

V= other miscellaneous indirect cost (Rs.)

II. Young sheep

$MIs_{YS} = A \times A2 \times B \times F \times (T+U+V)$

Where,

MIs_{YS}= Cost of miscellaneous loss in young sheep (Rs.)

A=Population of sheep

A1= Young animal population (%)

B= Incremental PPR prevalence (%)

D= Young animal morbidity (%)

T= Treatment cost of the animals (Rs.)

U= Increased cost of management including labour (Rs.)

V= other miscellaneous indirect cost (Rs.)

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Goats

15

1) Mortality loss in goats

I. $M_{AG} = A \times A1 \times B \times C \times G \times I$

M_{AG}=Loss due to mortality in adult goats (Rs.)

A = Population of goats

A1= Adult population (%)

B = Incremental PPR prevalence (%)

C = Adult mortality (%)

G = Average weight of adult (Kg)

I = Price of live weight animal (Rs./Kg)

II. $M_{YG} = A \times A2 \times B \times E \times H \times I$

M_{YG}= Loss due to mortality in young goats (Rs.)

A =Population of goats

A2= Young animal population (%)

B = Incremental PPR prevalence (%)

E = Young animal mortality (%)

H = Average weight of young one (Kg)

I = Price of live weight animal (Rs./Kg)

16

2) Losses due to body weight in goats

a) Loss due to reduction in body weight in goats

I. $BW_{AG} = A \times A1 \times B \times D \times G \times L \times I$

BW_{AG}= Loss due to Body weight in adult goats (Rs.)

A = Population of goats

A1= Adult population (%)

B = Incremental PPR prevalence (%)

D = Adult morbidity (%)

G = Average weight of adult (Kg)

L = Reduction in body weight due to morbidity (%)

I = Price of live weight animal (Rs./Kg)

II. $BW_{YG} = A \times A1 \times B \times F \times H \times L \times I$

BW_{YG}= Loss due to Body weight in Young goat (Rs.)

A = Population of goat

A2= Young animal population (%)

B = Incremental PPR prevalence (%)

F = Young animal morbidity (%)

H = Average weight of young animal (Kg)

L = Reduction in body weigh due to morbidity (%)

I = Price of live weight animal (Rs./Kg)

17

b) Live weight loss due to increased inter-kidding period

$BW_{IP} = A \times A1 \times B \times 0.5 \times [(12/P)-(12/P+Q)] \times M \times N \times I$

(Singh and Prasad 2009)

BW_{IP} = Cost of Body weight loss due to increased inter kidding period in adult female goat (Rs.)

A = Population of goat

A1 = Adult population (%)

B = Incremental PPR prevalence (%)

P = Inter-kidding period (months)

Q = Delay in next conception (months)

M = Average number of kids/kidding

N = Average birth weight of kid

I = Price of live weight animal (Rs./Kg)

c) Live weight loss due to increased Abortion

$BW_{AB} = A \times A1 \times B \times 0.5 \times O \times N \times I$

BW_{AB}= Cost of Body weight loss due to increased abortions in female goat (Rs.)

A=Population of goat

A1= Adult population (%)

B= Incremental PPR prevalence (%)

O= Proportion of female animals in abortion in percentage or increased abortion rate in percentage

N= Average birth weight of kid (kg)

I= Price of live weight animal (Rs./Kg)

18

3) Other Associated loss

a) Cost of high feeding and rearing inputs

I. Adults goat

FRI_{AG}= A x A1x B x D x R x S

FRI_{AG}= Cost of high feeding and rearing inputs in adult goat (Rs.)

A = Population of sheep

A1= Adult population (%)

B = Incremental PPR prevalence (%)

D = Adult Morbidity (%)

R = Price of feeding per animal/month in that particular period

S = Additional Period of feeding the animals in month

II. Young goat

FRI_{YG}= A x A2x B x F x R x S

FRI_{YG}= Cost of high feeding and rearing inputs in Young goat (Rs.)

A = Population of goat

A1= Adult population (%)

B = Incremental PPR prevalence (%)

F = Young animal morbidity (%)

R = Cost of feed incurred per animal/month

S = Additional Period of feeding (months)

19

3) Other Associated loss

b) Miscellaneous loss

I. Adults goat

Mis_{AG}= A x A1x B x D x (T+U+V)

Mis_{AG}= Cost of miscellaneous loss in Adult goat (Rs.)

A = Population of goat

A1= Adult population (%)

B = Incremental PPR prevalence (%)

D = Adult morbidity (%)

T = Treatment cost of the animals (Rs.)

U = Increased cost of management including labour (Rs.)

V = other miscellaneous indirect cost (Rs.)

II. Young goat

Mis_{YG}= A x A2x B x F x (T+U+V)

Mis_{YG}= Cost of miscellaneous loss in young goat (Rs.)

A = Population of goat

A1= Young animal population (%)

B = Incremental PPR prevalence (%)

D = Young animal morbidity (%)

T = Treatment cost of the animals (Rs.)

U = Increased cost of management including labour (Rs.)

V = Other miscellaneous indirect cost (Rs.)

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Results

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Table 2: Mortality and morbidity losses in sheep for various levels of incremental prevalence of PPR in India

Rs.Crores

Type of loss	Incremental Prevalence levels		
	5%	10%	15%
I.Mortality loss	193.9	387.7	581.6
	(77.4)	(77.4)	(77.4)
II. Morbidity loss			
I. Weight loss			
a. Direct losses due to reduction in body weight	12.3	24.8	37.0
	(5.2)	(5.2)	(5.2)
b. Live weight loss due to increased inter kidding period	21.8	43.8	65.9
	(9.9)	(9.9)	(9.9)
c. Live weight loss due to increased abortion	1.9	3.9	4.5
	(0.8)	(0.8)	(0.6)
II. Other associated losses			
a. Cost of high feeding and rearing inputs	11.1	22.2	33.3
	(4.7)	(4.7)	(4.7)
b. Miscellaneous loss*	7.9	15.0	33.9
	(3.5)	(3.1)	(3.1)
III. Total Loss	237.4	474.8	712.3
	(100)	(100)	(100)

* Includes treatment cost, increased cost of management and other minor costs

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Table 3: Mortality and morbidity losses in young and adult sheep for various levels of incremental prevalence of PPR in India

Rs.Crores

Type of loss	Age group*	Levels of Incremental Prevalence		
		5%	10%	15%
I.Mortality loss	Adult	111.4(58)	242.7(63)	364.0(63)
	Young	82.5(42)	145.0(37)	217.6(37)
	Total	193.9(100)	387.7(100)	581.6(100)
II.Morbidity losses				
a. Direct losses due to reduction in body weight	Adult	8.1(65.2)	16.1(65.2)	24.2(65.2)
	Young	4.3(34.8)	8.6(34.8)	12.9(34.8)
	Total	12.3(100)	24.8(100)	37.0(100)
b. Live weight loss due to increased inter kidding period	Adult	21(96)	42.1(96)	63.2(96)
	Total	21(96)	42.1(96)	63.2(96)
c. Live weight loss due to increased abortion	Adult	1.5(100)	3.0(100)	4.5(100)
	Total	1.5(100)	3.0(100)	4.5(100)
III. Other associated losses				
a. Cost of high feeding and rearing inputs	Adult	3.6(32.7)	7.3(32.7)	10.9(32.7)
	Young	7.5(67.3)	15.0(67.3)	22.3(67.3)
	Total	11.1(100)	22.2(100)	33.3(100)
b. Miscellaneous loss*	Adult	2.6(32.7)	5.3(32.7)	7.9(32.7)
	Young	5.1(67.3)	10.2(67.3)	15.3(67.3)
	Total	7.9(100)	15.5(100)	23.8(100)

*Includes treatment cost, increased cost of management and other minor costs, **Age group refers to Young (animals less than one year age), Adult (animals more than one year age)

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Table 4: Mortality and morbidity losses in goat for various levels of incremental prevalence of PPR in India

Rs.Crores

Type of loss	Levels of Incremental Prevalence		
	5%	10%	15%
I.Mortality loss	418.2	836.4	1254.6
	(73.7)	(73.7)	(73.7)
II. Morbidity loss			
I. Weight loss			
a. Direct losses due to reduction in body weight	28.2	56.3	84.7
	(5.0)	(5.0)	(5.0)
b. Live weight loss due to increased inter kidding period	75.3	150.6	225.9
	(13.3)	(13.3)	(13.3)
c. Live weight loss due to increased abortion	2.72	5.44	8.16
	(0.5)	(0.5)	(0.5)
II. Other associated losses			
a. Cost of high feeding and rearing inputs	26.7	53.3	77.3
	(4.5)	(4.5)	(4.5)
b. Miscellaneous loss*	17.5	35.0	52.5
	(3.1)	(3.1)	(3.1)
III. Total Loss	567.9	1135.8	1703.4
	(100)	(100)	(100)

* Includes treatment cost, increased cost of management including labour and other minor costs

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Table 5: Mortality and morbidity losses in young and adult goats for various levels of incremental prevalence of PPR in India

Rs.Crores

Type loss	Age group*	Levels of Incremental Prevalence		
		5%	10%	15%
I.Mortality loss	Adult	271.6(65)	543.3(65)	815.7(65)
	Young	146.6(35)	293.3(35)	439.2(35)
	Total	418.2(100)	836.4(100)	1254.9(100)
II.Morbidity losses				
a. Direct losses due to reduction in body weight	Adult	13.9(49.1)	27.2(49.1)	40.8(49.1)
	Young	14.3(50.9)	28.1(50.9)	42.9(51.9)
	Total	28.2(100)	56.3(100)	83.7(100)
b. Live weight loss due to increased inter kidding period	Adult	75.3(100)	150.6(100)	225.9(100)
	Total	75.3(100)	150.6(100)	225.9(100)
c. Live weight loss due to increased abortion	Adult	2.7(100)	5.4(100)	8.2(100)
	Total	2.7(100)	5.4(100)	8.2(100)
III.Other associated losses				
a. Cost of high feeding and rearing inputs	Adult	8.2(31.1)	16.3(31.1)	24.5(31.1)
	Young	17.9(68.3)	35.7(68.3)	53.5(68.3)
	Total	26.7(100)	53.3(100)	77.3(100)
b. Miscellaneous loss*	Adult	5.4(31.1)	10.7(31.1)	16.4(31.1)
	Young	12.1(68.3)	24.2(68.3)	35.4(68.3)
	Total	17.5(100)	35.0(100)	52.8(100)

*Includes treatment cost, increased cost of management and other minor costs, **Age group refers to Young (animals less than one year age), Adult (animals more than one year age)

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Table 6: Mortality and morbidity losses in goat and sheep for various levels of incremental prevalence of PPR in India

Rs.Crores

Type of loss	Levels of Incremental Prevalence		
	5%	10%	15%
I.Mortality loss	682.2	1364.3	2046.5
	(74.8)	(74.8)	(74.8)
II. Morbidity loss			
I. Weight loss			
a. Direct losses due to reduction in body weight	40.9	81.7	122.7
	(5)	(5)	(5)
b. Live weight loss due to increased inter kidding period	96.9	193.6	290.9
	(11)	(11)	(11)
c. Live weight loss due to increased abortion	4.22	8.44	12.66
	(0.5)	(0.5)	(0.5)
II. Other associated losses			
a. Cost of high feeding and rearing inputs	34.8	73.3	110.9
	(4.0)	(4.5)	(4.5)
b. Miscellaneous loss*	25.4	50.2	75.3
	(3.1)	(3.1)	(3.1)
III. Total Loss	885.2	1616.5	2418.7
	(100)	(100)	(100)

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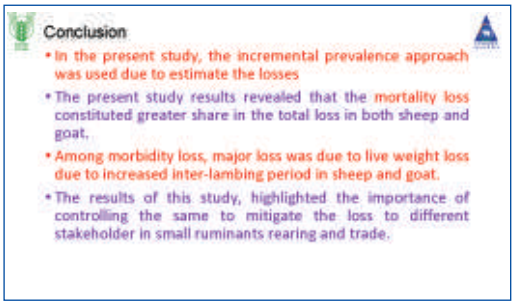

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1.4 Strategic Control of PPR disease in Andhra Pradesh

Sireesha S, Krishna Jyothi Y, Jyothi N and Reddy, G. Hanmanth
Veterinary Biological and Research Institute, Hyderabad

Andhra Pradesh state comprises of 25.50 million sheep and 9.60 million goat population as per the 2013 livestock census and stands number one in sheep population in the country. During 2005, a loss of Rs. 1265 million was estimated due to 533 PPR disease outbreaks in the state. During 2000 to 2007, on an average, 400 PPR outbreaks were recorded every year in the state. Therefore, an action plan was prepared for PPR control in the state by considering the disease outbreak data, population density, migration profiles, seasonality of the disease and availability of the vaccine. The Veterinary Biological and Research Institute, Hyderabad (VBRI) has been engaged in the production of PPR vaccine on a large scale using Sungri-96 attenuated strain supplied by IVRI since 2006.

A mass vaccination programme was carried out from January 2007 to March 2008 covering 82% sheep and goat population in the state based on the availability of PPR vaccine produced at VBRI followed by annual vaccination campaigns until 2010 to cover newborn young stock and unvaccinated animals. During this period, it was observed that there was considerable reduction in disease outbreaks.

In 2011, the Government of India launched the National Control programme for PPR and Andhra Pradesh implemented the pulse vaccination programme wherein the vaccination coverage was 85.20%. From 2012 to 2014, vaccination was continued on a half yearly basis based on the lambing pattern in young animals immediately after losing maternal antibodies and leftovers. Pre and post vaccination sero-monitoring (@0.01% of the total vaccinations) are in place and currently the disease is under control with maximum number of outbreaks limited to 3 as was reported during 2013-14. Therefore, with a strategic vaccination campaign, the disease can be kept under control which may

eventually lead to complete eradication of the disease from the country. Identification of unvaccinated animals, which also include 35-40% newly introduced animals, movement of animals in and out of the districts and farmers' insistence on repeat vaccination for vaccinated animals were the problems encountered in the field. Cold chain maintenance for storage of vaccines and wastage of vaccine in the field due to large number of doses in a vial were the problems related to the vaccine.

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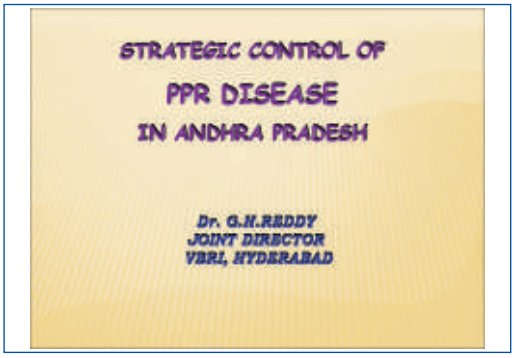

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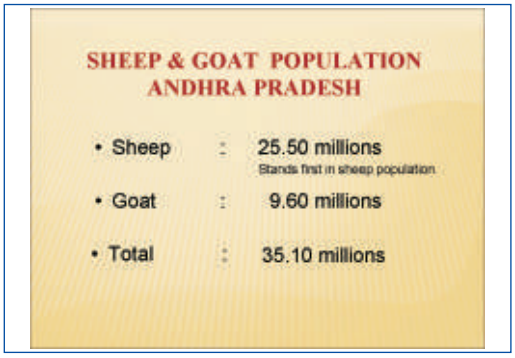

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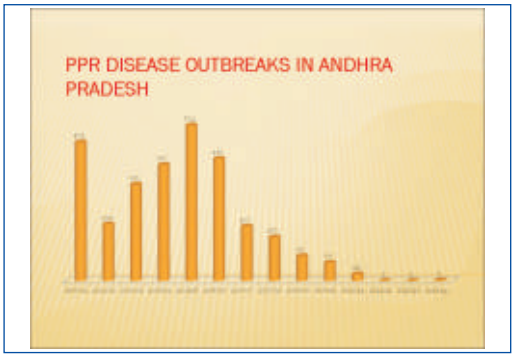

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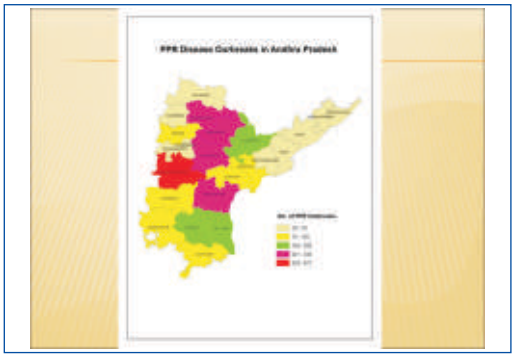

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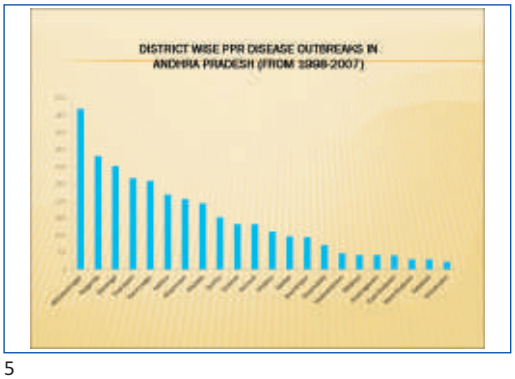

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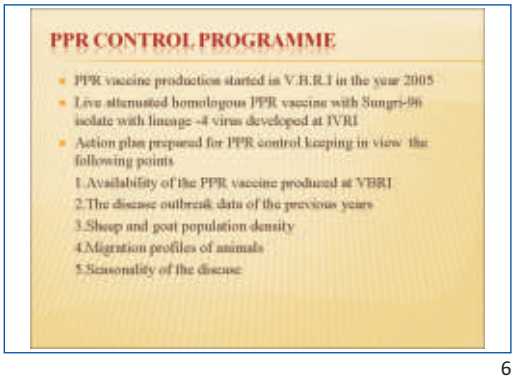

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PPR Mass Vaccination in Andhra Pradesh

Mass vaccination programmes conducted twice in the State:

1.State initiative – 2007 & 2008

2. NCPPPR – 2010-11

8

Mass vaccination - State initiative

Period	No. of Districts	Vaccine utilized in million doses	Remarks
Jan to March 2007	7	12.94	Vaccine also supplied to out break areas in other districts
April 2007 to March 2008	15	14.35	2.6 million doses also supplied to cover young unvaccinated animals in 7 districts

- Percentage of coverage 65 to 78
- Number of out breaks reduced from above 400 to below 100
- 2008-09 Covered young and unvaccinated animals
- 2009-10 Covered young and unvaccinated animals

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NCPPPR

1. Mass vaccination

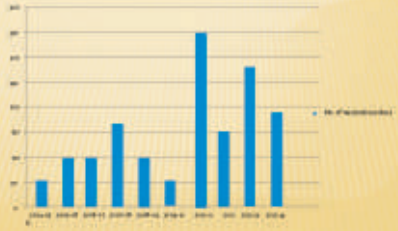
2010-11	35.00 millions doses of vaccine supplied	Vaccination done in four phases (from Dec,2010 to March,2011)	Percentage of coverage 85.2%

2. Follow up vaccination

- 2011-12 - Covered young and unvaccinated animals vaccinated in August and January
- 2012-13 - Covered young and unvaccinated animals vaccinated in August and January
- 2013-14 - Covered young and unvaccinated animals vaccinated in August and January

9

NUMBER OF PPR VACCINATIONS DONE IN ANDHRA PRADESH DURING THE LAST DECADE (x 1000 animals)



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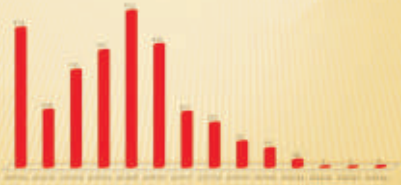
PPR DISEASE OUTBREAKS IN ANDHRA PRADESH



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PPR-SEROMONITORING

Year	Pre vaccinate samples		Post vaccinate samples	
	Samples tested	Positive samples(% positivity)	Samples tested	Positive samples (% positivity)
2007	370	73 (19.7)	370	300 (81.1)
2010	3655	2361 (64.6)	3516	3361 (95.6)
2011	1060	581 (55.1)	1056	961 (91.0)
2012	900	190 (19.3)	876	784 (89.5)
2013	3550	3024 (85.6)	3540	3344 (94.4)

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CHALLENGES IN DISEASE CONTROL

- Identification of unvaccinated young animals is a problem
- Farmers are insisting to vaccinate all animals in the flock by which young animals in other flocks are left uncovered.
- Hence out breaks reported in young animals which are in migration for grazing or marketing.
- Introduction of 35 to 40 % new population every year
- Animal movement control
- Cold chain maintenance / Thermo Stable Vaccine

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ACKNOWLEDGEMENTS

- Indian Council of Agricultural Research - Indian Veterinary Research Institute
  - Vaccine seed virus
  - Sandwich ELISA kits
  - Competitive ELISA kits
- Dept. of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Govt. of India for supporting the Control Prog.
- Govt. of Andhra Pradesh for implementing the programme

14

1.5 Status of *Peste des Petits Ruminants* (PPR) in India

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Peste des Petits Ruminants (PPR) is one of the highly contagious and economically important, notifiable viral disease of small ruminants, which causes substantial loss to farmers. PPR is enzootic in India as outbreaks occur regularly throughout the country, resulting in economic losses in terms of morbidity (50 to 100 %) and mortality (10 to 100%). Even though India is endemic to PPR, North-Eastern states are relatively free from the disease or experience negligible number of outbreaks. The disease outbreak in Eastern states was more during summer and more during rainy season in the Western states. The Southern states experienced more outbreaks in winter while it was more in winter and summer seasons in the Northern states.

In India, many districts of Andhra Pradesh, Karnataka, West Bengal, Himachal Pradesh, Jammu and Kashmir, Odisha and West Bengal fall under the high and moderate pathozone. However, Southern states like Karnataka and Andhra Pradesh have reported a decline in the number of PPR outbreaks during the years 2006-2010, which can probably be due to regular vaccination and monitoring. States like West Bengal, Madhya Pradesh, Maharashtra and Rajasthan have reported an increasing trend in PPR occurrence during the last five years. Therefore, it is essential to undertake vaccination programme on priority in high endemic districts in each state, and subsequently, medium and low endemic areas. For effective control of disease, vaccination should be followed by deworming. Awareness about diagnosis and control of the disease among farmers could help in early diagnosis and effective control of the disease. Vaccination camps should be conducted before outbreak season and cover kids of 3 months and above age.

The availability of an effective vaccine, accurate diagnostic tests for PPR and an experienced human resource prompt us to propose a national project for eradication of PPR on the lines of National Project on Rinderpest Eradication, by creating a common platform involving all stakeholders working in development of small ruminants.

Please find the detailed information as given below:

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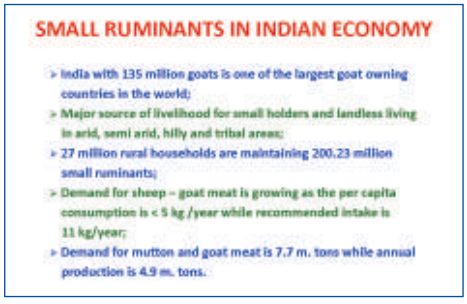

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HEALTH CHALLENGES IN SMALL RUMINANTS

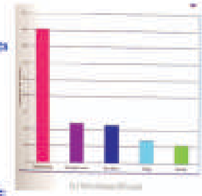
- Viral Diseases : Foot and Mouth Disease, Peste Des Petits Ruminants , Sheep - Goat Pox, Blue Tongue;
- Bacterial Diseases : Hemorrhagic Septicemia, Black Quarter, Enterotoxaemia, Anthrax, Brucellosis;
- Endoparsites : Haemonchosis, Fasciolosis, Oesophagostomosis;
- Ectoparasites : Mites (*Sarcoptes spp*), Fleas (*Ctenocephalides spp.*), Ticks *Boophilus spp. Ixodes spp;*
- Protozoan Diseases : Coccidiosis.

3

PPR - A CHALLENGE IN SMALL RUMINANTS

Diseases affecting Small Ruminants

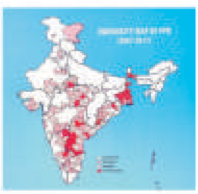
- PPR disease - 34.5% loss
- FMD - 14.5%
- Sheep and Goat Pox - 14.1%
- CCP - 6.4%
- Enterotoxaemia - 6.1%
- Fasciolasis / Distomatosis - 5.0%
- Anthrax - 2.0%



Reported Financial losses due to PPR:
Over Rs. 1800 million (USD39 million)

4

PPR - A CHALLENGE IN SMALL RUMINANTS



Classification of Endemicity:

- *Hyper Endemic States:* Andhra Pradesh, West Bengal, Karnataka
- *Highly Endemic States:* Odisha, Maharashtra, Tamil Nadu
- *Low Endemic States:* Madhya Pradesh, Jharkhand, Rajasthan
- *Sporadic Endemic States:* Punjab, Jammu & Kashmir, Haryana

5

DIFFERENT CATEGORIES OF ENDEMIC DISTRICTS IN INDIAN STATES

States	SR Population under Risk		SR Rearing Families under risk of PPR (000)	Different Categories of Endemic Districts		
	Goat	Sheep		Hyper Endemic	Endemic	Sporadic
AP	8027121	16195181	2440	M.nagar, Kurnool	Medak, Cuddapah	Visakhapatnam
Gujarat	4958972	1707750	885	-	Bhavnagar, Anand	Rajkot, Junagadh
Jammu and Kashmir	2017998	3359405	5864	-	-	Leh (Ladakh)
Jharkhand	6582448	582825	1818	-	-	Palamu
Karnataka	4784147	9583766	1742	Gulbarga, Tumkur	Koppal, Bagalkot	Bellary
Kerala	1246077	1444	222	-	Palakkad (Palghat)	Thiruvananthapuram, Malappuram

6

DIFFERENT CATEGORIES OF ENDEMIC DISTRICTS IN INDIAN STATES

States	SR Population under Risk		Families under risk of PPR (000)	Different categories of endemic districts		
	Goat	Sheep		Hyper Endemic	Endemic	Sporadic
Madhya Pradesh	8013006	338963	758	Shivpuri, Chhindwara	Chhatarpur, Raisen	Satana, Vidisha
Maharashtra	8400007	2380281	894	Nagpur, Nasik	Osmanabad, Jalgaon	Chandrapur, Dhule
Odisha	6519087	1582129	841	Koraput, Keonjhar	Mayurbhanj, Nayagarh	Sambalpur
Punjab	327172	128934	151	-	Ludhiana	Ferozpur, Jalandhar
Rajasthan	21665939	9079702	1782	Kota	Baran, Udaipur	Alwar, Bhilwara
Tamil Nadu	8143341	4786680	1296	Salem	-	The Nilgiris, Dindigul
West Bengal	11505953	1570115	886	Purulia, Birbhum	Hooghly, Bankura	Kolkata, Midnapur East
Total	174909598	61181444	17992			

7

MONTH WISE INCIDENCES OF PPR IN SHEEP AND GOATS

Sr. No.	Month	Percent Positive	
		Sheep	Goats
1.	April	28.7	27.8
2.	May	41.7	18.8
3.	June	-	64.9
4.	July	20.0	21.1
5.	August	44.7	79.1
6.	September	32.5	48.0
7.	October	23.1	49.0
8.	November	25.0	28.1
9.	December	2.4	28.8
10.	January	9.1	17.6
11.	February	12.9	16.4
12.	March	21.8	51.5

8

SEASONAL INCIDENCES IN PESTE DES PETITS RUMINANTS

- **Eastern States :** Summer Season
- **Western States :** Rainy Season
- **Northern States :** Summer and Rainy Seasons
- **Southern States :** Winter Season

9

BAIF GOAT DEVELOPMENT PROGRAMME

States	Breeds	Family Coverage	PPR Outbreaks	
			Months	Mortality %
Odisha	Ganjam Black Bengal	25000	Jan - Feb Aug - Nov	24 - 56
Jharkhand	Black Bengal	30000	Nov - Feb	35-50
M.P.	Sirohi	60	January	33.88
Rajasthan	Sirohi Marwadi	4025	Dec - Feb	2 %

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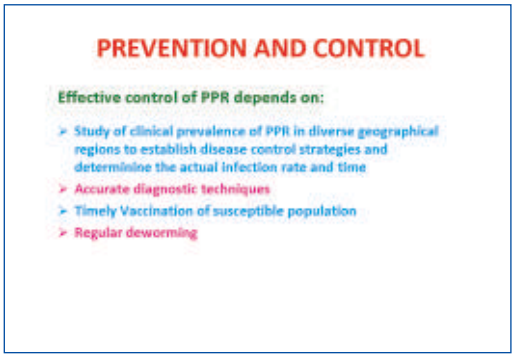

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Chairman's Remarks

PPR is an endemic disease, found throughout the country. Goat keepers are more enlightened about the disease compared to sheep farmers. There is a need for a study to know why the disease is more severe in sheep in the Southern states and more severe in goats in the Northern states. Animal migration is an important reason for spread of the disease. Early diagnosis and disease reporting are necessary for effective control. Vaccine is available in the country but efficient cold chain is essential for protecting the animals. Mass vaccination followed by repeat vaccination of young and uncovered animals could help in reducing the incidences and mortality.

TECHNICAL SESSION 2:
Status of Diagnostics and Vaccine Production: Problems and Opportunities

Chairman: Dr. Mohinder Oberoi

Animal Health Consultant, FAO Expert, Ludhiana

2.1 A Study to Analyse the Infectivity Titres of *Peste des Petits Ruminants* (PPR) Vaccine produced in Roller Cultures

S. Sireesha, S. Madhavi, S. Vasundara, N. Jyothi and G. Hanmanth Reddy

Veterinary Biological and Research Institute, Hyderabad

As PPR disease control programme is underway in India, there is a demand for large quantities of vaccine. In this context, a study was carried out to analyse the infectivity titres of PPR vaccine produced in stationary and roller cultures. PPR vaccine virus was propagated in 300 cm^2 tissue culture (TC) flasks and 1800 cm^2 roller bottles under uniform cultural conditions and infected with uniform multiplicity of infection of PPR vaccine virus. The medium was changed on alternate days after post-infection. When 80% cytopathic effect (CPE) was achieved, all the flasks were harvested. These viral harvests were freezed, thawed twice and pooled. Assessment of infectivity titres revealed that there were two log higher titres in roller cultures compared to that of 300 cm^2 TC flask cultures.

The total titre obtained per flask and the quantity of harvest obtained per flask were significantly higher in the roller bottles. Further, the medium utilized and man-hours required for roller cultures were comparatively less. Therefore, it is opined that roller cultures are more economical in PPR vaccine virus production. Nowadays, micro-carrier system is also recommended as an alternate procedure for PPR vaccine production as it yields higher titre compared to stationary cultures. However, the two log increases in the titre observed in micro-carrier cultures was also observed in roller cultures. Moreover, the technology of roller cultures is similar to that of routine TC flask cultures. Hence, this system can be applied with the available expertise and laboratory set up only with addition of a Roller apparatus. Therefore, roller bottle culture method is more useful and economical for biological units particularly state biological units to meet their state vaccine needs for the on-going PPR control programme.

Please find the detailed information as given below:

PRODUCTION OF HIGH TITRE PESTE DE PETITS RUMINANTS (PPR) VACCINE VIRUS ON ROLLER CULTURES

Dr. S.Sireesha
Assistant Director(AH),
PPR production unit,
VBRI, Hyderabad

1

CONTROL OF PPR DISEASE

Major steps in control of disease:

- Organized PPR vaccinations
- Control of movement
- Systematic surveillance of the disease

2

- Organised vaccinations can take place if sufficient quantities of vaccine is available.
- Lack of sufficient vaccine in India for PPR control programme.
- Long duration for establishing new production facilities.
- Focus on Increasing the production capacity of existing facilities

3

Scenario In Andhra Pradesh

- Huge sheep and goat population.
- Need to increase production capacity to cater the state needs and to supply to other states for the control programme

4

Various methods to increase the PPR vaccine production capacity

- Roller cultures
- Suspension cultures
- Microcarriers

5

Why roller cultures ?

- Microcarriers or suspension cultures need infrastructure and time for standardization.
  - Difficult to produce vaccine immediately.
- Roller cultures similar to TC flask cultures.
  - Easy to adapt with an addition of a Roller apparatus

6

study carried out to compare and analyze the infectivity titres of PPR vaccine produced in stationary and roller cultures.

7

- Apart from the yield of vaccine a comparison was also done on various aspects of production of a fixed batch size :

1. Number of flasks required
2. Quantity of medium required
3. Number of man hours
4. Total cost of production

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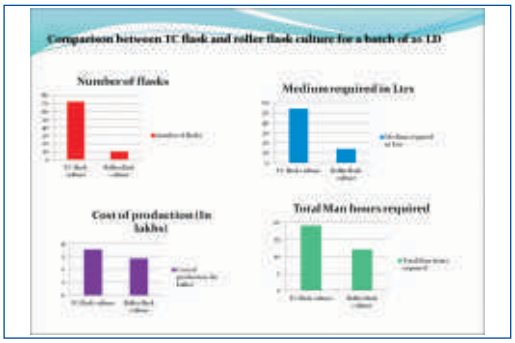

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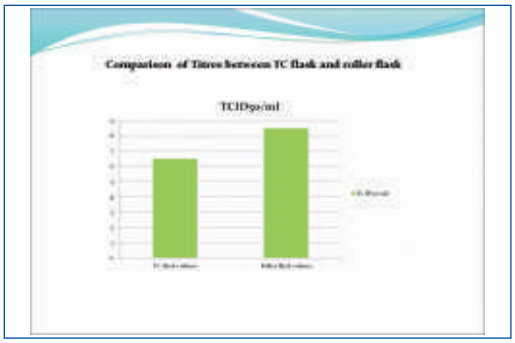

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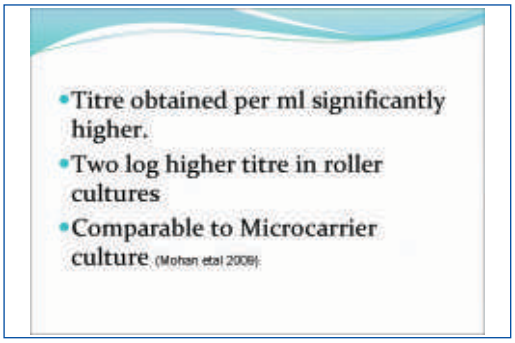

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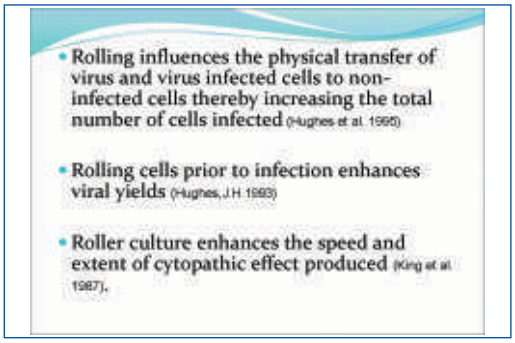

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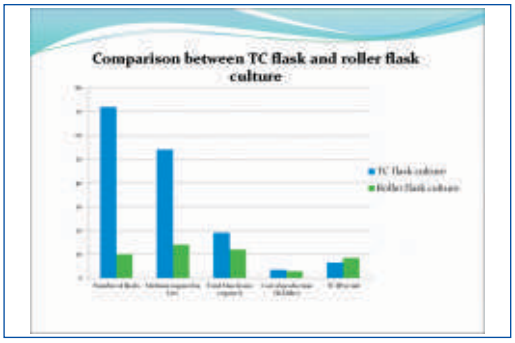

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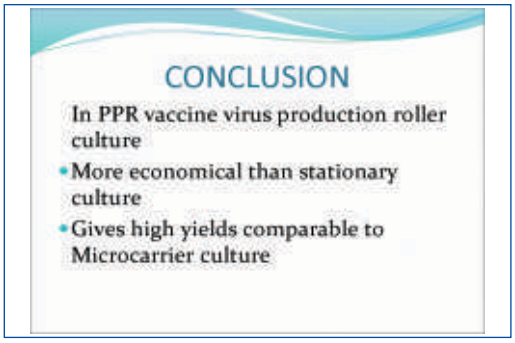

14

2.2 In-vitro Selection and Molecular Characterization of a Monoclonal Antibody resistant Mutant of an Indian strain of *Peste des Petits Ruminants* Vaccine Virus

B. Getachew, A.E. Haq, V. Upmanyu, K.K. Rajak, D. Muthuchelvan, B. Sharma and R.P. Singh

Division of Biological Products, Indian Veterinary Research Institute, Izatnagar 243122

Peste des Petits Ruminants (PPR), also known as goat plague, is a viral disease of small ruminants caused by single stranded, negative sense RNA virus. In the present study,

monoclonal antibody resistant (mAr) mutant of an Indian strain of PPR vaccine virus (Sungri/96 strain) was isolated and characterized after passaging in the presence of "anti-Haemaglutinin (H)" virus neutralizing monoclonal antibody 4B11. Subsequently, five mutant populations of viruses namely PPRV-RM5, PPRV-RM6, PPRV-RM7, PPRV-clone E6 and PPRV-Clone E7 were isolated. Mutant populations were selectively reactive to anti-Nucleocapsid mAb 4G6 but non-reactive to anti-H mAb 4B11 using indirect, cell based ELISA and indirect fluorescent test. Findings indicate that there is a loss of epitope to mAb 4B11. At genomic level, two amino acid substitutions, both leading to proline, separated widely apart (L263P and R502P), in the linear sequence of the H-protein, were identified. These changes may be responsible for 4B11 resistant phenotype. The mAr mutant was fit for growth in Vero cells and did not revert back after twenty passages without mAb pressure. The isolated mutant virus was antigenically similar to vaccine virus, except with the reactivity of mAb 4B11. Investigations, on in-vivo applications of the isolated variants as possible negative marker vaccine proved that the epitope corresponding to mAb 4B11 has some competitive / overlapping epitope in the neighbourhood. Besides this, the findings may help in identifying the epitope to mAb 4B11 which seems to be conformational in nature. This is the first report on generating a mAr mutant to PPR virus based on the available literature.

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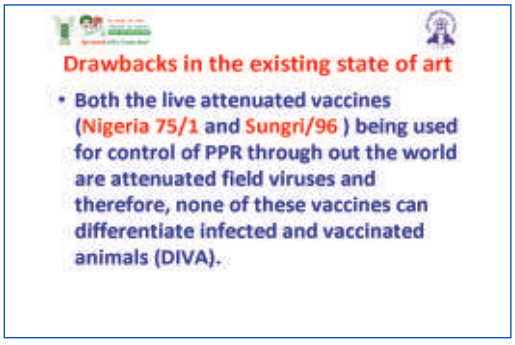

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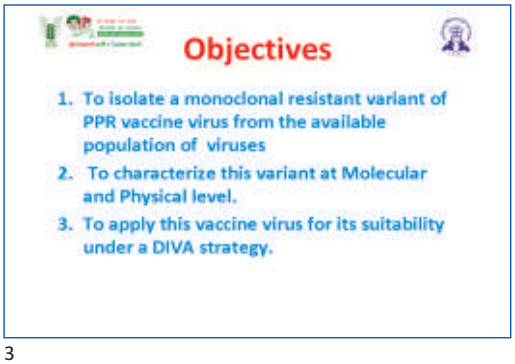

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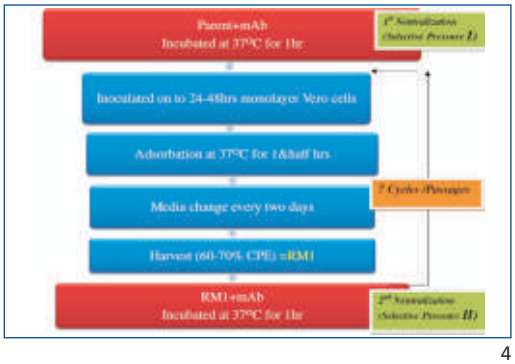

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Three population of mutants (RM5,RM6&RM7) at different passage level and two virus clones (E6 & E7) were generated and isolated

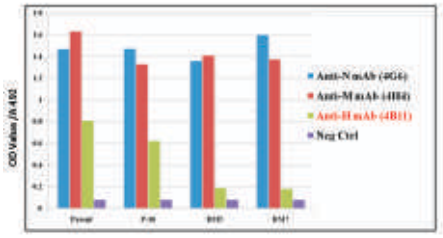
5

CHARACTERIZATION

1. *Binding Assay*
   - *IFT*
   - *Indirect ELISA*
   - *Cell based ELISA*
   - *Flowcytometry*
   - *VNT*
   - *Haemagglutination*
3. *Virus Fitness Assay*
   - *Growth Kinetics*
   - *CPE*
   - *Virus Titration*
   - *Thermostability*
4. *Reversion study*
   - *Passaging,Ind.Ab P/- & Binding assay*
2. **Genotypic characterization**
   - *Sequence of H-gene*
   - *Sequence Analysis*

6

Binding assay using indirect ELISA



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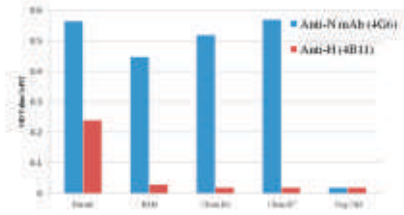
Reactivity of PPR clone E6 &E7 viruses in comparison to parent & RM6 virus using Indirect ELISA



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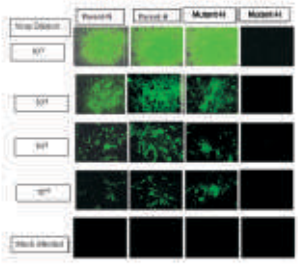
Reactivity in FAT



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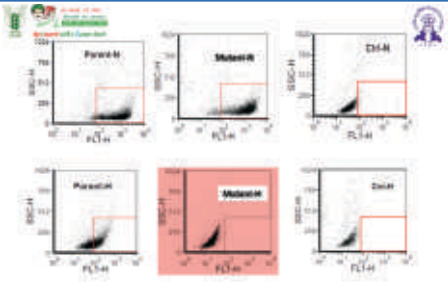
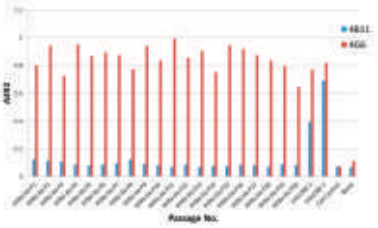


Indirect flowcytometry assay

10

Reactivity of 20 Passages



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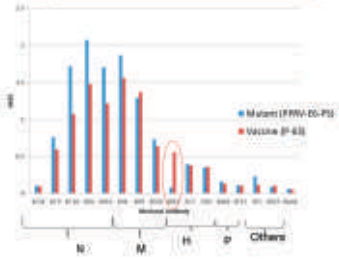
Antigenic Characterization by MAbs



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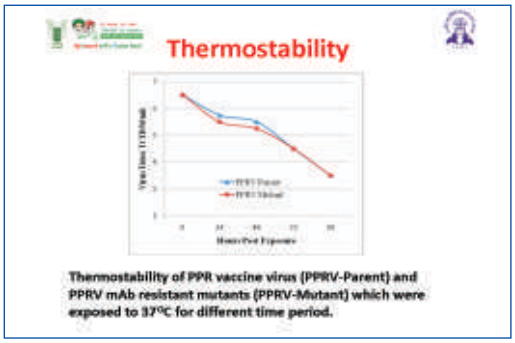

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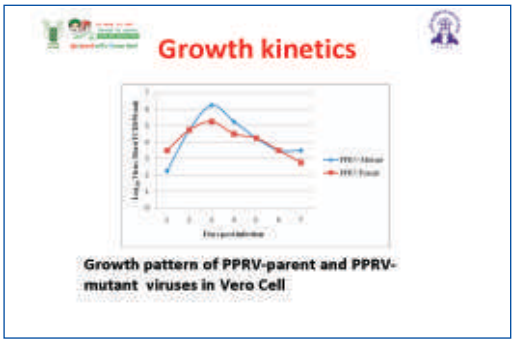

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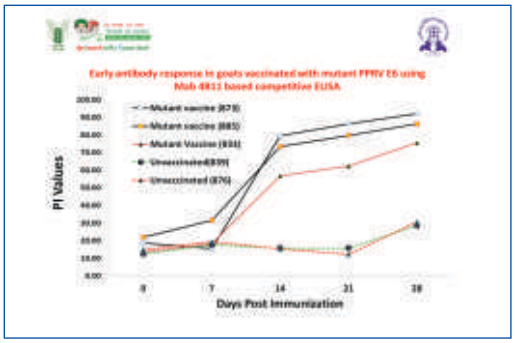

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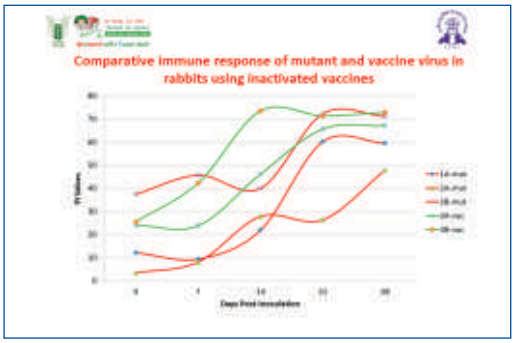

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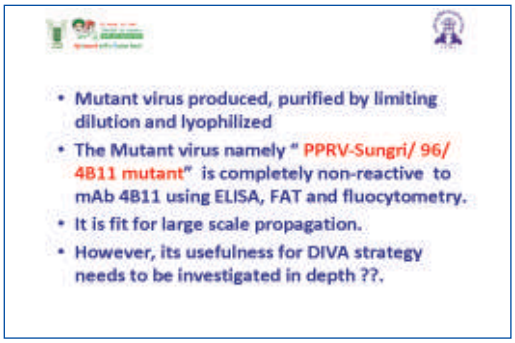

18

2.3 Safety and Efficacy Profile of Ovilis® PPR Vaccine in Goats and Sheep

B. Mathivanan, S. Kilari, V. Moulin and P. Joosten
MSD Animal Health, Pune
MSD Animal Health, Boxmeer, the Netherlands

Peste des Petits Ruminants (PPR) or goat plague is a highly contagious, economically important viral disease of goats and sheep with high morbidity in adult and high mortality

in young ones. Ovilis® PPR vaccine was developed with a live attenuated Sungri strain obtained from the Indian Veterinary Research Institute (IVRI). Safety and efficacy profile of Ovilis® PPR vaccine was evaluated in young goats and sheep.

Safety of the vaccine was tested by injecting 100 doses in goat kids, checked for any clinical signs up to 21 days post-vaccination (DPV). Dissemination, spreading and excretion of vaccine virus were checked by sacrificing these vaccinated animals kept together with unvaccinated controls at regular intervals. Various vital organs and excreta from these animals were analyzed for the presence of PPR virus by real-time quantitative polymerase chain reaction (qPCR). Efficacy of the vaccine was tested in young goats and sheep by injecting single dose of vaccine and then subject to challenge infection with virulent PPR virusat 21 DPV. Clinical observations were recorded and the blood samples were analyzed by qPCR for viraemia and for sero-conversion by virus neutralization test (VNT).

There were no clinical signs of PPR disease in the vaccinated animals and virus could be detected only in the lymphatic organs. There was no excretion and spread of vaccine virus to the sentinels or among control animals coming in contact. Vaccinated sheep and goats received clinical protection from challenge infection whereas all control animals showed classical signs of PPR clinical disease. There was no viraemia in the vaccinated animals unlike unvaccinated control animals upon challenge infection. To summarize, Ovilis® PPR vaccine is found to be safe and efficacious in goats and sheep since there is no excretion of vaccine virus and provides clinical protection by preventing viraemia.

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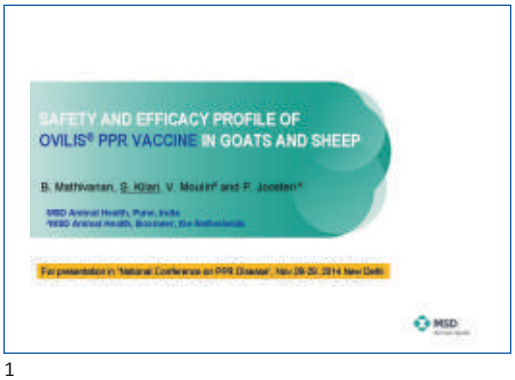

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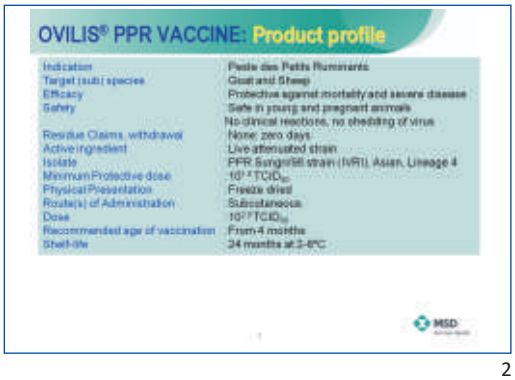

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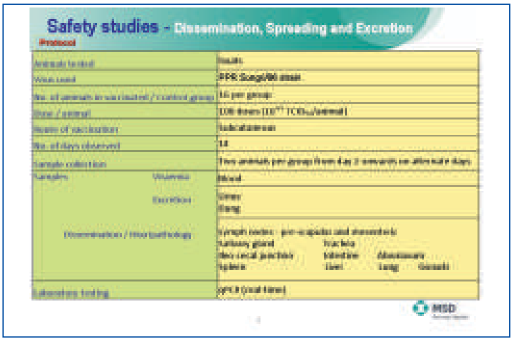
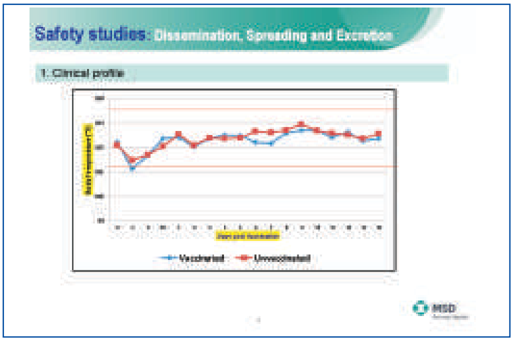
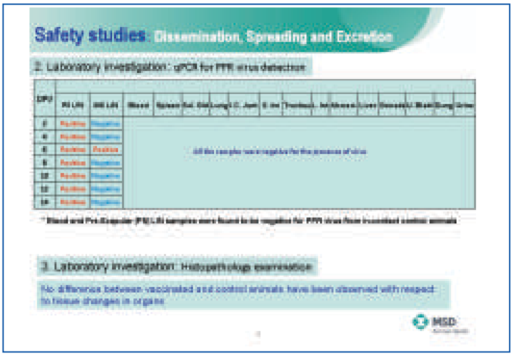

Safety studies - Dissemination, Spreading and Excretion
Protocol
Blood
qPCR (real time)
MSD

3


Safety studies: Dissemination, Spreading and Excretion
1. Clinical profile
Vaccinated
Unvaccinated
MSD

4


Safety studies: Dissemination, Spreading and Excretion
2. Laboratory investigation : qPCR for PPR virus detection
DPV
Blood
Positive
Negative
3. Laboratory investigation: Histopathology examination
No difference between vaccinated and control animals have been observed with respect to tissue changes in organs
MSD

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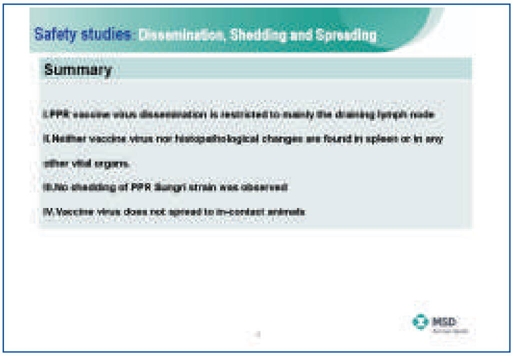
Safety studies: Dissemination, Shedding and Spreading
Summary
I.PPR vaccine virus dissemination is restricted to mainly the draining lymph node
II.Neither vaccine virus nor histopathological changes are found in spleen or in any other vital organs.
III.No shedding of PPR Sungri strain was observed
IV.Vaccine virus does not spread to in-contact animals
MSD

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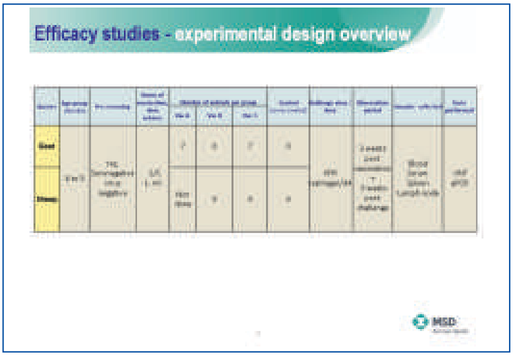
Efficacy studies - experimental design overview
Goat
Sheep
MSD

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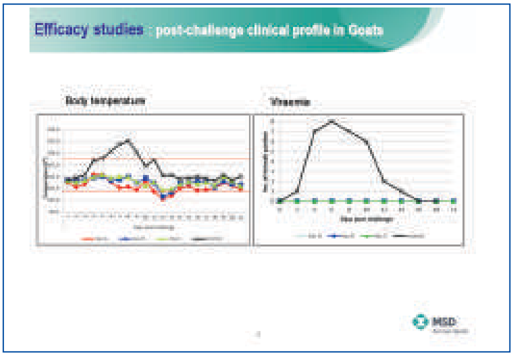
Efficacy studies : post-challenge clinical profile in Goats
Body temperature
Viraemia
MSD

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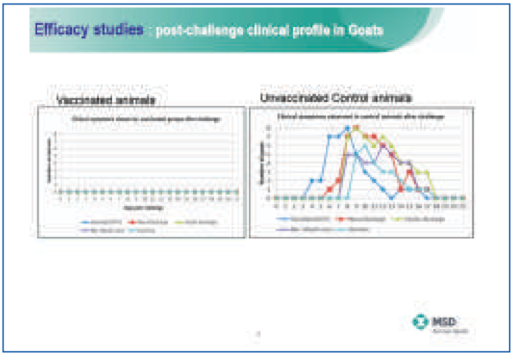
Efficacy studies : post-challenge clinical profile in Goats
Vaccinated animals
Unvaccinated Control animals
MSD

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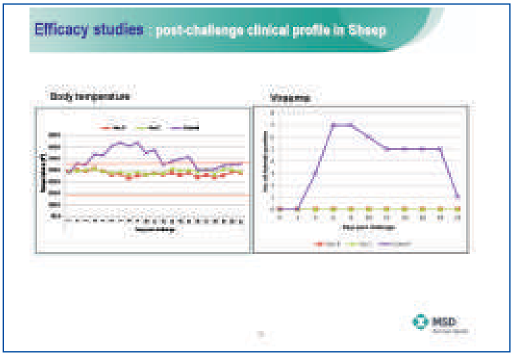
Efficacy studies : post-challenge clinical profile in Sheep
Body temperature
Viraemia
MSD

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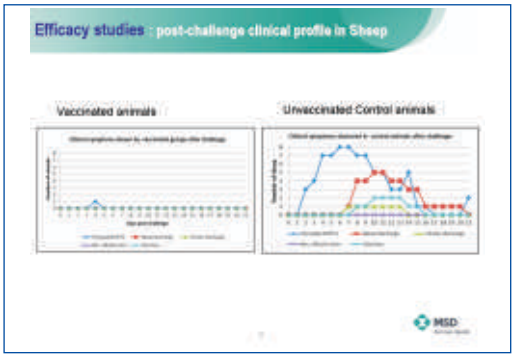

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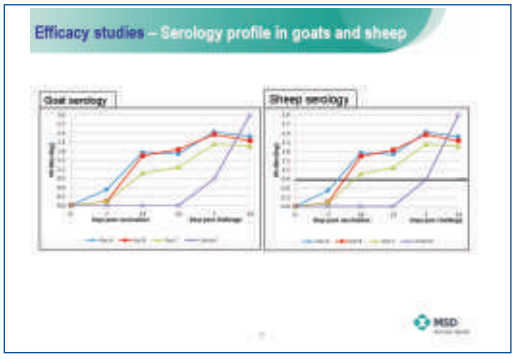

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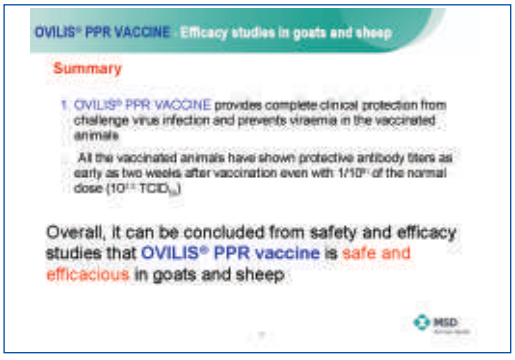

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2.4 Molecular epidemiology of *Peste des Petits Ruminants* Viruses: 10-Year Study

Z. Ahmad, K.K. Rajak, D. Muthuchelvan, R. Kumar, D. Chaudhary, R.K. Singh and A B. Pandey

Indian Veterinary Research Institute, Campus Mukteswar, Nainital 263 138, Uttarakhand, Indian Veterinary and Research Institute, Izatnagar, Bareilly, UP

Peste des Petits Ruminants (PPR) is one of the most important viral diseases of sheep and goats in India caused by PPR virus. In the present study, field samples received at PPR laboratory at IVRI, Mukteswar in the past decade (2004-13) were subjected to laboratory investigations. Sandwich ELISA was used for initial screening. A total of 50 clinical specimens with optical density of over one were used for molecular epidemiology. Partial sequencing of F gene (322 bp) and N gene (255 bp) were carried out. The sequence analysis revealed nucleotide identity of 97.2-100% and 92.5-100% at the F and N gene respectively. The phylogenetic analysis grouped all the viruses in Lineage IV. Two sub clusters could be identified among the lineage IV viruses. Findings re-confirm the fact that only lineage IV virus is in circulation in India.

Please find the detailed information as given below:

Molecular epidemiology of *Peste-des-petits ruminants* Viruses: 10 year study

D. Muthuchelvan
Senior Scientist
IVRI-Mukteswar

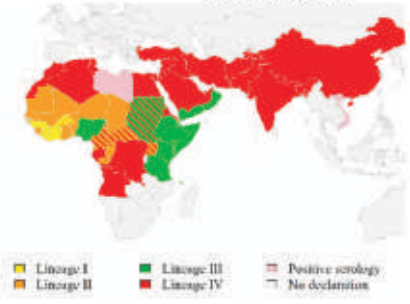
1

PPR

- Transboundary in nature
- PPR virus: One serotype and four lineages (1-4)
- Commercial vaccine- Sungri/96 & Nig/75/1
- Commercial diagnostics- IVRI, BDSL, IDVET
- No DIVA vaccine in India

2

Libeau et al., 2014



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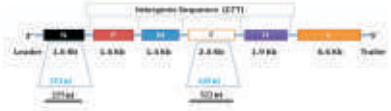
Taxonomy

- New members: Feline morbillvirus & mobilli-like viruses in rodents & bats
- CeMV- New genetically divergent strain (Parida et al., 2014)



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New strain of PPRV?

- PPRV in Camels-(El-Hakim, 2006; Roger et al., 2001)
- PPRV in buffalo-(Govindarajan et al., 2007)
- PPRV in felids- (Balamurugan et al., 2012)
- New strain of PPRV in goats not detectable by commercial s-ELISA- (Kumar et al., 2013)

5

Study design & Results

Clinical samples from 2004 to 2013(n=200)

6

Sample spread

7

Sequence analysis

PERCENT IDENTITY AT NUCLEOTIDE LEVEL				
Within Samples	Lineage 1	Lineage 2	Lineage 3	Lineage 4
95.8-100%	82.4-86.7 %	83.9-88.6%	77.3-83.9%	90.2-98.8%

PERCENT IDENTITY AT AMINO ACID LEVEL				
Within Samples	Lineage 1	Lineage 2	Lineage 3	Lineage 4
92.5-100%	78.8-85.9 %	79.2-87.5%	72.2-82.7%	94.9-98.8%

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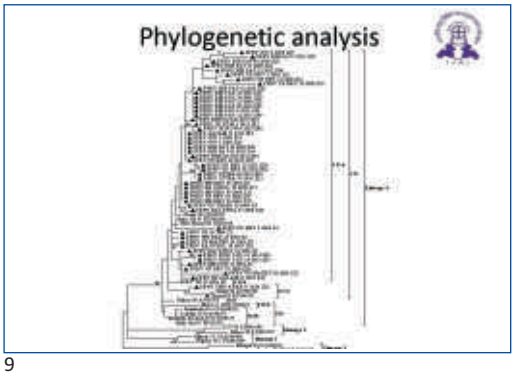

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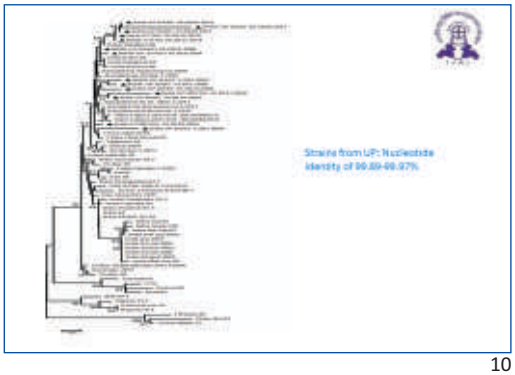

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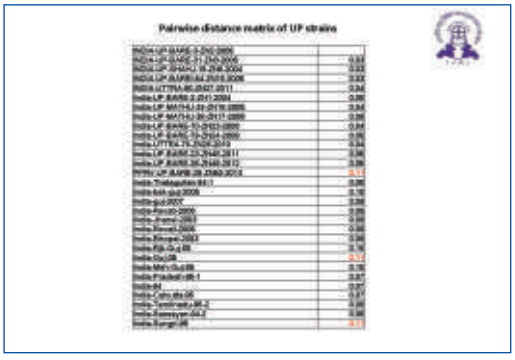

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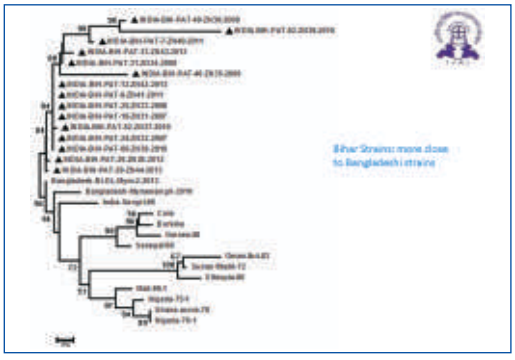

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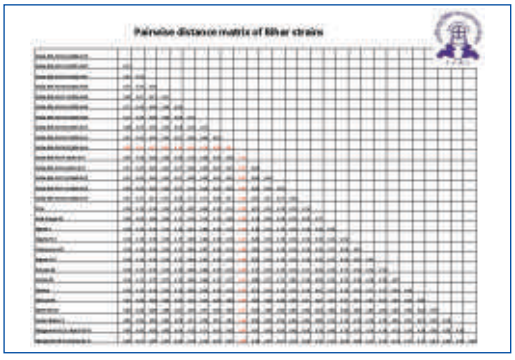

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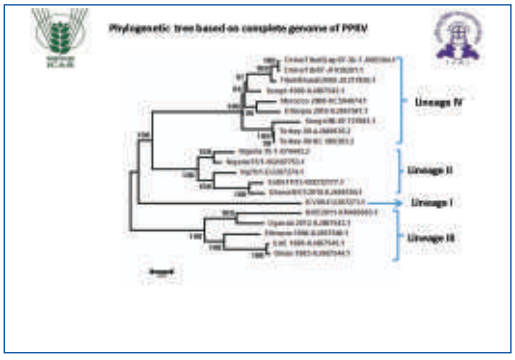

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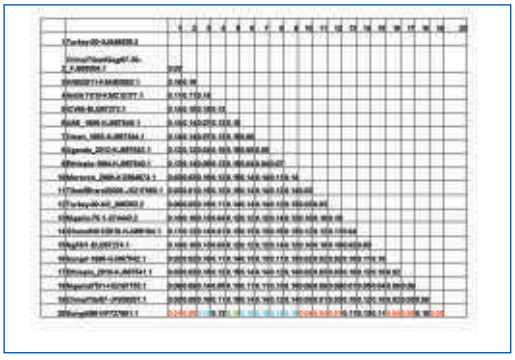

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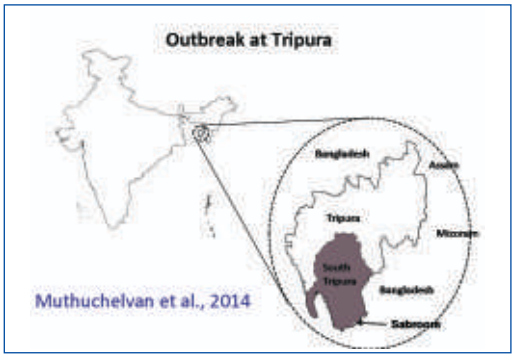

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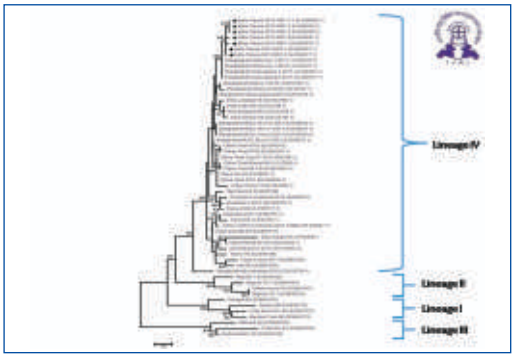

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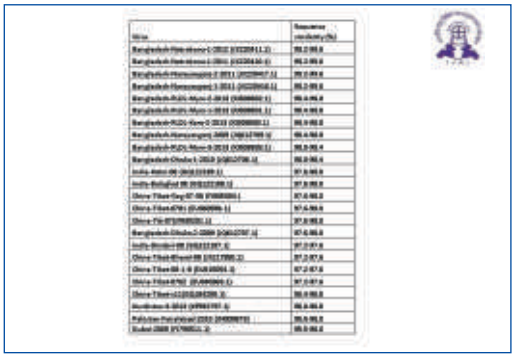

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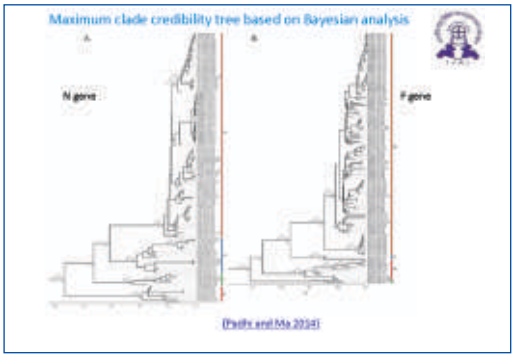

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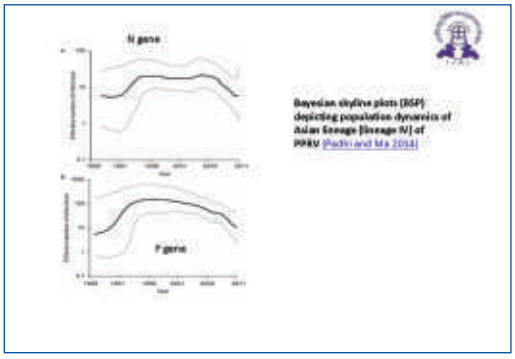

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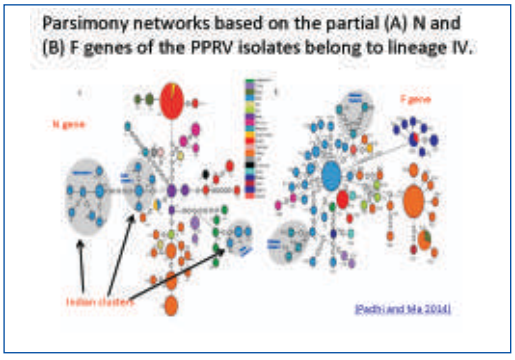

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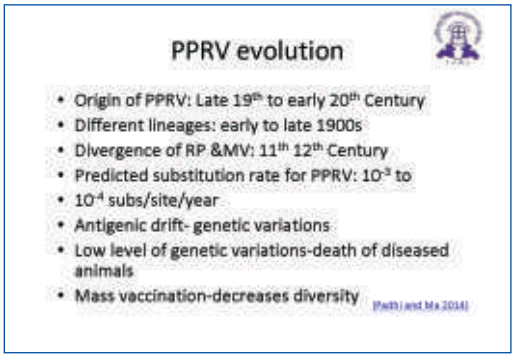

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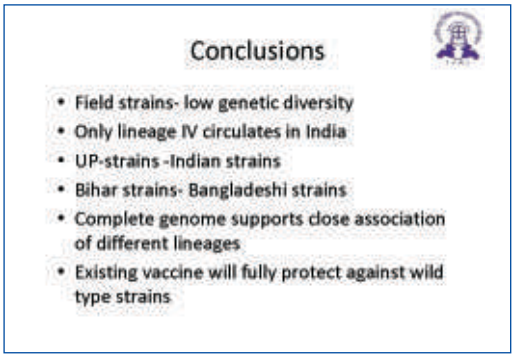

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2.5 Detection of *Peste des Petits Ruminants* virus by reverse transcription isothermal loop-mediated amplification

Maan S, Kumar A, Batra K, Jindal, N, Sunayna, Mahajan N.K, Singh A, Maan N.S and Kumar A.

Departments of Animal Biotechnology, Veterinary Public Health and Epidemiology, Veterinary Microbiology, COVS, LLRUVAS, Hisar, Haryana

Peste des Petits Ruminants (PPR) is a contagious viral disease prevalent among small ruminants. It is endemic in several African, Middle Eastern and Asian countries, including India. In this study, a one-step RT-LAMP assay for the detection of PPR virus was developed. RT-LAMP primer sets that target highly conserved regions of PPRV genome were designed using Primer Explorer ver 4.0 available at Eiken Chemical Co. Ltd. The assay detected the virus rapidly, within 30-60 minutes, and the result could be visualized either by resolving the ladder pattern of LAMP amplicons in agarose gel electrophoresis or development of green colour in LAMP-positive tubes by adding picogreen dye. The assay detected viral RNA in all the PPRV-positive samples, including field strains and Vero cell adapted virus isolates. Analytic sensitivity of RT-LAMP was found to be comparable to that of real-time RT-PCR, but higher than that of conventional PCR. The PPR specific LAMP primers did not amplify RNA from foot-and-mouth disease virus (FMDV) and blue-tongue virus (BTV) that produce clinical signs resembling those of PPR. This test is highly specific to PPR virus and unable to detect other viruses.

The RT-LAMP assay developed for detection of PPR virus has the advantages of high sensitivity,rapidity and ease of performance under isothermal conditions. The test is particularly suitable for use in 'front-line' diagnostic facility and mobile diagnostic unit, and has potential for field-adaptation as a 'penside' test to help in early diagnosis and containment of field outbreaks in the sub-continent.

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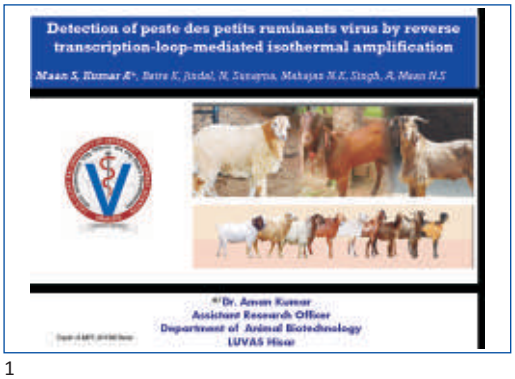

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2

Background

Epidemiological study

3

Background

PPR in sheep and goat (July 2010 to June 2011).

4

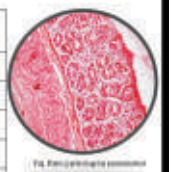
Background

PPR in Sheep & Goat (July 2011 to June2012)

5

Background

PPR in sheep & goat (July 2012 to June 2013)



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Background

Epidemiological data generated during last four year

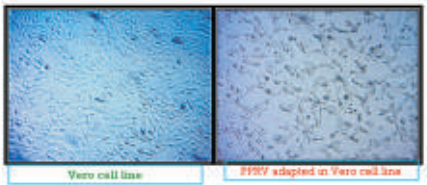
7

Background Contd.....

- Nowadays laboratory confirmation of PPR is usually done through different types of ELISA and several nucleic acid based amplification techniques e.g. RT-PCR, RT-nPCR and RT-qPCR.
- However, virus isolation still remains the gold standard diagnostic Technique.
- These techniques are effective in detecting the virus but they are expensive time consuming and difficult to apply in laboratories with limited resources.
- In this scenario a novel isothermal amplification method termed as loop mediated isothermal amplification (LAMP) has potential to detect PPRV in a very simple rapid, and highly sensitive manner from field samples.
- In this study we develop a diagnostic method based on LAMP assay to detect PPRV.

8

Laboratory confirmation of PPRV through virus isolation



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The LAMP assay

- Loop mediated isothermal amplification (LAMP) is a single tube technique for the amplification of DNA.
- It may be combined with a reverse transcriptase step to allow the detection of RNA.
- LAMP is a novel approach to nucleic acid amplification which uses a single temperature (65°C) incubation thereby obviating the need for expensive thermal cyclers.
- Detection of amplification product can be by phonometry for turbidity caused by increasing quantity of Magnesium pyrophosphate in solution or with addition of SYBER-green, a color change can be seen without equipment.

10

The LAMP assay - advantages

- LAMP is isothermal and uses simple unmodified primer sets for the target DNA amplification so it is a particularly useful method for infectious disease diagnosis in low and middle income countries.
- This method has simplicity, ruggedness, rapidity and is cost effective.
- LAMP is widely being studied for detecting infectious diseases such as tuberculosis malaria, and sleeping sickness, in developing regions, it has yet to extensively validated for other common pathogens.

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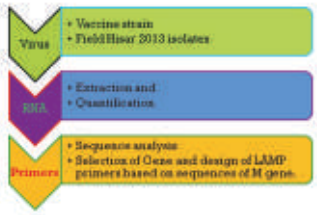
Materials and Methods



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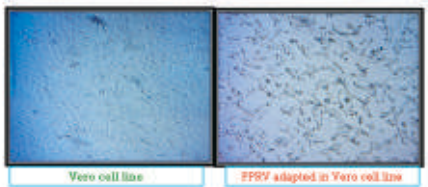
Optimisation of LAMP assay

13

Results and discussion

Laboratory confirmation of PPRV through virus isolation



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Designing of LAMP Primers

Mgenes of PPRV was used for designing LAMP primers designated as PPRV-F3, PPRV-B3, PPRV-FIP ,PPRV-BIP,PPRV-LF and PPRV-LB Primers were designed using Eilaos, Tokyo, Japan; http://primerexplorer.jp Primer Explorer 4.

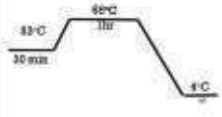
Newly designed primers

Name	Sequence (5'-3')	Position
PPRVM-F3	CTCTAGGGTTCGTTAGTTC	239
PPRVM-B3	GTTGACTGCATTGCAAACCT	416
PPRVM-FIP	GTGCGCCTTCACCACTATGTCTTTTTAACTGCTAAGCTAGAGGAAC	291
PPRVM-BIP	AACAACACTCCGCTGTCCTTTTTTTTAACACACTTCGGTTGTCAG	345
PPRVM-LF	AGTTCTGTGCCTCCCTT	273
PPRVM-LB	ACGCCCTGTAAGGAAAGTT	367

15

Optimized reaction mixture

Sr.no	Reaction component	Concentration
1.	10X LAMP Buffer	2.5 µl
2.	100mM MgSO4	3.0µl
3.	5mM dNTPs	5.0 µl
4.	F3 (2pm)	0.5µl
5.	B3(2pm)	0.5µl
6.	FIP(16pm)	1.0 µl
7.	BIP(16pm)	1.0 µl
8.	LF(8pm)	0.5µl
9.	LB(8pm)	0.5µl
10.	Bst Enzyme	1.0µl
11.	RNA template	5.0µl
12.	Bst DNA polymerase	0.5µl
13.	Reverse transcriptase	0.5µl
	Total	25.0µl



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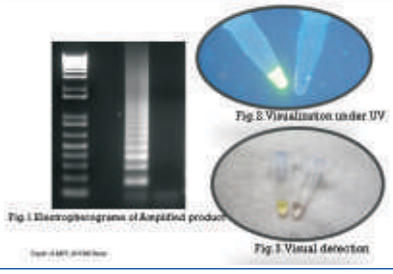
Analysis of RT-LAMP products



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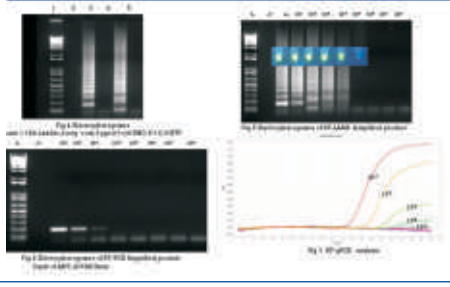
Determination of Specificity and Senstivity of RT-LAMP



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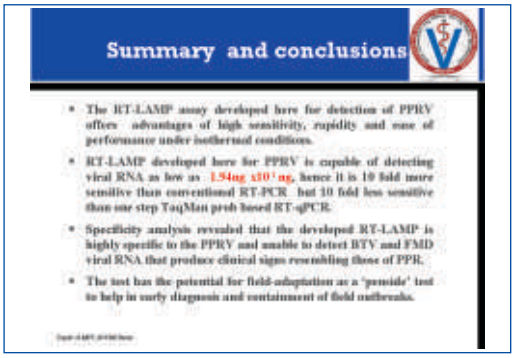

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2.6 Thermostability Profile of Ovilis® PPR Vaccine

B. Mathivanan, S. Kilari, V. Moulin and P. Joosten
MSD Animal Health, Pune
MSD Animal Health, Boxmeer, the Netherlands

Peste des Petits Ruminants (PPR) disease of goats and sheep can be effectively controlled by preventive mass vaccination of healthy animals like successful eradication of Rinderpest (RP) disease globally. The main challenge for an effective implementation of mass vaccination campaign for the control of PPR disease is to have a potent vaccine at the time of vaccination at the farmer's doorstep. Ovilis® PPR vaccine developed at MSD Animal Health based on live attenuated Sungri strain from Indian Veterinary Research Institute (IVRI) was evaluated for its stability as per Drugs and Cosmetics Act of India (1948) at elevated temperature ranges of 30±1°C, 37±1°C and 45±1°C apart from shelf-life storage temperature of +2 to 8°C. Potency of Ovilis® PPR vaccine batches stored at refrigeration temperatures of +2 to 8°C has been maintained for at least 27 months so far. However, vaccine potency lasts for a short period and it varies depending on the elevated temperature zone. Potency of the vaccine was retained as long as 2 weeks when it was stored at +30±1°C and for a day at +37±1°C but less than a day when stored at +45±1°C.

To conclude, Ovilis® PPR vaccine has maintained its potency for at least two years when stored at a recommended temperature of +2 to 8°C.

Please find the detailed information as given below:

Thermostability of OVILIS® PPR VACCINE

B. Mathivanan, S. Kilari, V. Moulin* and P. Joosten*

For presentation in "National Conference on PPR Disease", Nov 28-29, 2014 New Delhi

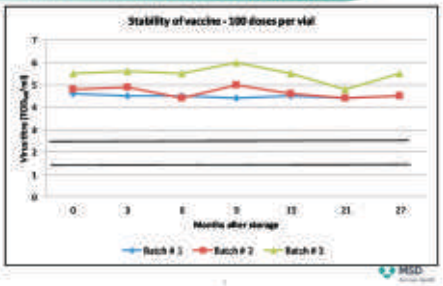
1

OVILIS® PPR VACCINE : Introduction

- Peste des petits ruminants (PPR) disease of goats and sheep can be effectively controlled by preventive mass vaccination of healthy animals similar to the one followed for Rinderpest (RP) eradication.
- Principle challenge is to have a stable, potent vaccine till the farmer's doorstep at the time of vaccination.
- Vaccines are required to be stored +2 to 8°C or below
- Ovilis® PPR vaccine developed at MSD Animal Health has been evaluated for its stability at elevated temperature ranges of 30±1°C, 37±1°C and 45±1°C apart from its shelf-life storage temperature of +2 to 8°C.

2

OVILIS® PPR VACCINE : storage at +2 to 8°C



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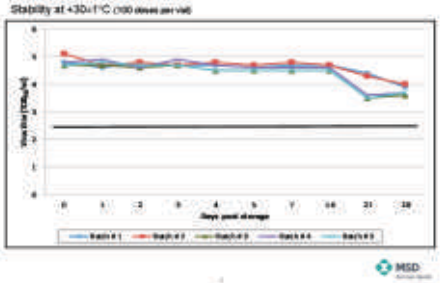
OVILIS® PPR VACCINE : at elevated temperature



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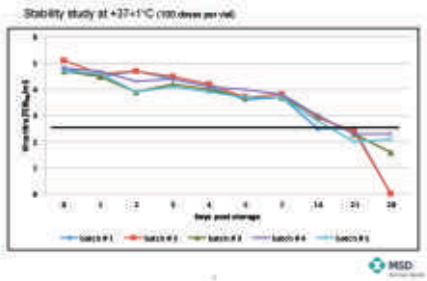
OVILIS® PPR VACCINE : at elevated temperature



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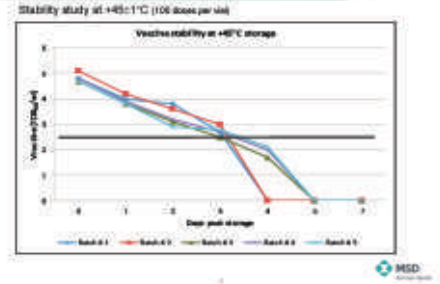
OVILIS® PPR VACCINE : at elevated temperature



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OVILIS® PPR VACCINE : Summary

- **Ovilis® PPR vaccine** retains its potency / efficacious titer at least for 24 months when stored at refrigeration temperature of +2 to 8°C
- Additional stability data do indicates that vaccine retains its potency / efficacious titer for two weeks when storage temperature does not exceed +30±1°C and for one day, if it exceeds +37±1°C

7

Thanks

8

Discussion and Conclusion

It was reported that antibodies could be isolated in vaccinated animals 9 days after vaccination, although the general belief is that two weeks are required to develop immunity. The viral strain found in infected sheep and goats was the same. However in goat population dominated areas, the disease symptoms were first seen in goats and sheep were infected first in sheep dominated areas.

Vaccination can cover advanced pregnant animals as well. However precaution should be taken, because if the animals are suffering from certain ailments or high load of endoparasites, there can be some adverse reaction, which may lead to abortion.

Observations of the Vaccine Manufacturers

India has been producing good quality vaccine and 160 million doses excess capacity is available. Cost of vaccination is also fairly low. The areas of concern are delay in diagnosis, timely reporting of the disease, poor cold chain network, unavailability of skilled vaccinators and timely vaccination.

Efforts should be made to strengthen the cold chain facilities and distribution network. Vaccine manufacturers can also be involved in disease diagnosis, training of vaccinators and post vaccination monitoring, which can help in disease control. Training of local youth as vaccinators will be helpful for timely vaccination. The programme should have a holistic perspective.

Research is in progress to produce nasal vaccine and thermo-stable vaccine, which can be more effective in protecting the animals. Further encouragement is needed to promote higher investment in research and new technologies.

TECHNICAL SESSION 3:
Challenges of PPR Vaccination and Disease Control

Chairman: Dr. Satya Parida

Head, Vaccine Differentiation Group, Institute for Animal Health, Pirbright, U.K.

3.1 Control and Eradication of PPR - Role of Recombinant Vaccines

N. Pulicherla

Indian Immunologicals Ltd., Hyderabad 500032

Peste des Petits Ruminants (PPR), a highly infectious and economically important viral disease prevalent in goats and sheep, is currently being managed with a live-attenuated vaccine. Although the live-attenuated vaccines are cost effective and provide a strong immunity, there is a need to develop new vaccines which could aid in the differentiation of infected from vaccinated animals (DIVA), an important feature in disease surveillance.

Improving the thermal stability of the vaccine will also be helpful in avoiding cold chain-associated problems, especially in rural areas. Several research groups have developed a new generation of recombinant PPR vaccines, which include combination vaccines, marker vaccines, virus-like particles offering selective advantages over the conventional vaccines. While the efficacy of some of these potential vaccine candidates has been demonstrated in target animals, further optimization might be required for inclusion of all the desired features in one vaccine. Serious efforts in this direction can bring out novel PPR vaccines which along with companion diagnostic tests will be immensely helpful for the control and eradication of this deadly disease. Combination of Capri pox and PPR vaccine for sheep and Goat pox and PPR can be effective in cost and control of disease. These vaccines can be produced separately and mixed at final stage of packing.

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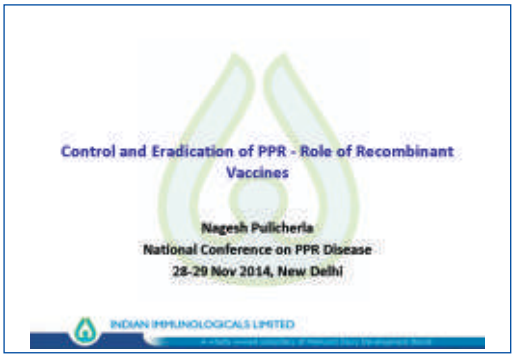

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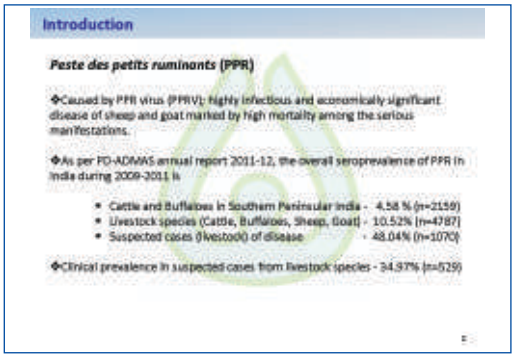

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Rationale

PPR vaccines

As per OIE Terrestrial Manual 2013 -
- Sheep and goats vaccinated with an attenuated strain of PPR (or that recover from PPR) develop an active life-long immunity against the disease
- Several homologous PPR vaccines are available, containing cell culture-attenuated strains of natural PPRV
- To date, no recombinant/ marker vaccine is commercially available

Need for a recombinant vaccine

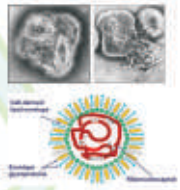
- Marker vaccine - DIVA
- Combination vaccines - cost effective
- Thermal stability - logistics

3

Background

Peste des petits ruminants virus (PPRV)

- Morbillivirus, family - Paramyxoviridae
- Enveloped virus, genome consists of a 15kb ss (-) RNA encoding six structural and two non-structural proteins
- Nucleocapsid (N) protein encapsulates the virus genomic RNA
- Phosphoprotein (P) associated with the polymerase (L) protein
- Fusion (F) protein and the haemagglutinin (H) protein associated with the cell-derived envelope
- Matrix (M) protein, link between the nucleocapsid and the glycoproteins (H and F)



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Recombinant vaccines

- **Virus-like Particles (VLP)**
  - Insect cell expression of glycoproteins
- **Viral vectored vaccine**
  - Adenoviral vector
  - Vaccinia
  - MVA
- **Viral vectored + Combination vaccine**
  - FMDV + PPR
  - Capripox + PPR

5

Recombinant vaccines

Virus-like Particles (VLP)

- Li W, Jin H, Sui X, Zhao Z, Yang C, Wang W, Li J, Li G. Self-assembly and release of **peste des petits ruminants virus-like particles** in an insect cell-baculovirus system and their immunogenicity in mice and goats. PLoS One. 2014 Aug 12; 9(8):e104791.

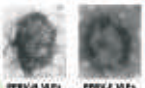
- Liu F, Wu X, Zhao Y, Li L, Wang Z. Budding of **peste des petits ruminants virus-like particles** from insect cell membrane based on intracellular co-expression of peste des petits ruminants virus M, H and N proteins by recombinant baculoviruses. J Virol Methods. 2014 Oct;207:78-85.

- Liu F, Wu X, Li L, Liu Z, Wang Z. Formation of **peste des petits ruminants spikeless virus-like particles** by co-expression of M and N proteins in insect cells. Res Vet Sci. 2014 Feb;96(1):215-6.

6

Strategy

- VLPs of PPRV were generated using a baculovirus system through simultaneous expression of PPRV matrix (M) protein and haemagglutinin (H) or fusion (F) protein.
  - Strain: PPRV vaccine strain (Nig75/1)
  - Propagation: *Spodoptera frugiperda* (Sf21) insect cells
  - Medium: Sf-900II serum-free medium (Invitrogen)



- Animal studies: 20 outbred goats (6–24 months of age), divided into four groups of five each.
- Vaccinated subcutaneously with 300 µg PPRV-H or PPRV-F VLPs diluted in 1 mL of PBS and 1 mL PPRV Nig75/1 ($10^{5.5}$ TCID50), as positive control. Booster provided 3 weeks later (same dose)
- Results: elicited PPRV-specific IgG production, increased the levels of virus neutralizing antibodies, and promoted lymphocyte proliferation.
- Pros: DIVA Cons: cost of production

7

Recombinant vaccines

Adenoviral vector

- Rojas JM, Moreno H, Valcárcel F, Peña L, Sevilla N, Martín V. Vaccination with **recombinant adenoviruses expressing the peste des petits ruminants virus F or H proteins** overcomes viral immunosuppression and induces protective immunity against PPRV challenge in sheep. PLoS One. 2014 Jul 11; 9(7):e101226.

- Rojas JM, Moreno H, García A, Ramírez JC, Sevilla N, Martín V. Two **replication-defective adenoviral vaccine vectors** for the induction of **immune responses to PPRV**. Vaccine. 2014 Jan 9;32(3):395-400.

- Wang Y, Liu G, Chen Z, Li C, Shi L, Li W, Huang H, Tao C, Cheng C, Xu B, Li G. Recombinant **adenovirus expressing F and H fusion proteins** of peste des petits ruminants virus induces both humoral and cell-mediated immune responses in goats. Vet Immunol Immunopathol. 2013 Jul 15;154(1-2):1-7.

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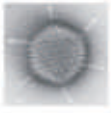
Recombinant vaccines



Adenoviral vector

- Herbert R, Baron J, Batten C, Baron M, Taylor G. Recombinant **adenovirus expressing the haemagglutinin** of Peste des petits ruminants virus (PPRV) protects goats against challenge with pathogenic virus; a DIVA vaccine for PPR. Vet Res. 2014 Feb 26;45:24.

- Qin J, Huang H, Ruan Y, Hou X, Yang S, Wang C, Huang G, Wang T, Feng N, Gao Y, Xia X. A novel **recombinant Peste des petits ruminants-canine adenovirus vaccine** elicits long-lasting neutralizing antibody response against PPR in goats. PLoS One. 2012;7(5):e37170.

9

Strategy

- Replication defective human Ad5 adenoviruses expressing F, H or an F-H fusion protein.
- Replication-competent recombinant canine adenovirus type-2 (CAV-2) expressing the H gene of PPRV is also studied.
- PPRV strains Nigeria 75/1 or Ivory Coast'89 (ICV) (lineages I and II)
- Human embryonic kidney (HEK 293) cells and MDCK cells
- Animal studies: Goats and Sheep
  - neutralizing antibodies were detected in sera from immunized animals.
  - In addition, a significant antigen specific T-cell response was detected in vaccinated animals.
  - Importantly, no clinical signs and undetectable virus shedding were observed after virulent PPRV challenge in vaccinated animals.
- Advantages of Ad vectors: DIVA, moderate thermal stability

10

Recombinant vaccines

Other Vectors

❖Iones I, Glavedoni L, Sallé JT, Brown C, Mebus C, Yilma T. Protection of goats against peste des petits ruminants with a **vaccinia virus** double recombinant expressing the F and H genes of rinderpest virus. Vaccine. 1995;11(9):961-4.

❖Yin C, Chen W, Hu Q, Wen Z, Wang X, Ge J, Yin Q, ZN H, Xia C, Bu Z. Induction of protective immune response against both **PPRV and FMDV** by a novel recombinant PPRV expressing FMDV VP1. Vet Res. 2014 Jun 4; 45:62.

❖Buczkowski H, Parida S, Bailey D, Barrett T, Barnard AC. A novel approach to generating morbillivirus vaccines: negatively marking the rinderpest vaccine. Vaccine. 2012 Mar 2;30(11):1927-35.

❖Chandran D, Reddy KB, Vijayan SP, Sugumar P, Rani GS, Kumar PS, Rajendra L, Srinivasan VA. **MVA** recombinants expressing the fusion and hemagglutinin genes of PPRV protects goats against virulent challenge. Indian J Microbiol. 2010 Sep;50(3):266-74.

11

PPR + FMDV Combination

- A recombinant PPRV expressing the FMDV VP1 gene (rPPRV/VP1). FMDV VP1 gene was inserted in the genome cDNA of PPRV N75/1 between the P and M genes
- Vaccine strain Nigeria 75/1
- Propagated in Vero cells
- Animal studies: Goats were immunized by intramuscular injection at the neck with a 50% tissue culture infective dose (TCID50) of $6*10^5$ rPPRV/VP1 or N75/1
- FMDV VP1 expression did not impair replication of the recombinant virus in vitro and immunogenicity in inducing neutralizing antibody against PPR in goats.
- Vaccination with one dose of rPPRV/VP1 induced FMDV neutralizing antibody in goats and protected them from challenge with virulent FMDV.
- Pros: Potential dual live vectored vaccine against PPRV and FMDV
- Cons: a higher dosage ($6 * 10^5$ TCID50) was used to elicit neutralizing antibody response and protection efficacy against FMDV. Multiple recombinant viruses required for protection against FMDV

12

Recombinant vaccines

Viral vector + Combination: Capripox + PPR

❖Caufour P, Rufael T, Lamien CE, Lancelot R, Kidane M, Awel D, Sertse T, Kwiatek O, Libeau G, Sahle M, Diallo A, Albina E. **Protective efficacy of a single immunization** with **capripoxvirus vectored** recombinant peste des petits ruminants vaccines in presence of pre-existing immunity. Vaccine. 2014 Jan 24;32(30):3773-9.

❖Berhe G, Minet C, Le Goff C, Barrett T, Ngangnou A, Grillet C, Libeau G, Fleming M, Black DN, Diallo A. Development of a **dual recombinant vaccine** to protect small ruminants against peste-des-petits-ruminants virus and **capripoxvirus** infections. J Virol. 2003 Jan;77(2):1571-7.

❖Diallo A, Minet C, Berhe G, Le Goff C, Black DN, Fleming M, Barrett T, Grillet C, Libeau G. Goat immune response to **capripox vaccine expressing the hemagglutinin protein** of peste des petits ruminants. Ann N Y Acad Sci. 2002 Oct;969:88-91.

❖Chen W, Hu S, Gu L, Hu Q, Zhang Q, Zhi H, Huang K, Bu Z. A **goat poxvirus-vectored** peste-des-petits-ruminants vaccine induces long-lasting neutralization antibody to high levels in goats and sheep. Vaccine. 2010 Jul 5;28(30):4742-50.

13

Recombinant vaccines

Viral vector + Combination: Capripox + PPR

❖Chaudhary SS, Pandey KD, Singh RP, Verma PC, Gupta PK. A vero cell derived combined vaccine against **sheep pox and Peste des Petits ruminants** for sheep. Vaccine. 2009 Apr 28;27(19):2548-53.

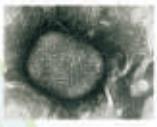
❖Hosamani M, Singh SK, Mondal B, Sen A, Bhanuprakash V, Bandyopadhyay SK, Yadav MP, Singh RK. A bivalent vaccine against **goat pox and Peste des Petits ruminants** induces protective immune response in goats. **Vaccine.** 2006 Aug 28;24(35-36):6058-64.

❖Romero CH, Barrett T, Kitching RP, Bostock C, Black DN. Protection of goats against peste des petits ruminants with **recombinant capripoxviruses** expressing the fusion and **haemagglutinin protein** genes of rinderpest virus. Vaccine. 1995 Jan;13(1):36-40.

14

Strategy

- Capripox: Goat pox, Sheep pox
- *Poxviridae*: virus particles are generally enveloped, size is around 200 nm in diameter and 300 nm in length
- Genome: single, linear, double-stranded DNA (150kb)



- Bivalent vaccine comprising attenuated strains of *Peste des Petits ruminants* virus (PPRV) and goat poxvirus (GTPV) was evaluated in goats and sheep.
- Bivalent vaccine was found to be safe and induced protective immune response in goats and sheep as evident from sero conversion as well as challenge studies

15

Capripox vectored PPR

- Two recombinant CPV viruses, rCPV-PPRVH and rCPV-PPRVF, that express PPR virus (PPRV) glycoproteins H and F, respectively.
- Strains: attenuated CPV vaccine strain KS-1 (Kenyan0240 strain) and attenuated PPRV vaccine strain Nigeria 75/1
- Animal studies: carried out in goats and sheep, vaccine dose of 10^7TCID$_{50}$
- Potent inducer of neutralizing antibodies and protected against CPV and PPR challenges.
- Two doses of rCPV-PPRVH could overcome the interference caused by pre-existing immunity to the CPV vaccine backbone in animals
- An ideal vector for the development of recombinant vaccines for use against ruminant diseases - can protect goats against two diseases that are of great economic importance in many developing countries. Other advantage – DIVA
- Duration of immunity has to be evaluated. Negative impact of CPV pre-immunity on the protection conferred by rCPV-PPR vaccines against PPR.
- Several parameters modulating the extent of interference that include the attenuated viral strain, the inoculated vector dose, the immunization route, the transgene with its associated expression promoter, as well as the vaccination regimen including homologous or heterologous boosts.

16

Strategies

Thermal Stability

❖Silva AC, Yami M, Libeau G, Carrondo MJ, Alves PM. Testing a **new formulation** for **Peste des Petits Ruminants** vaccine in Ethiopia. Vaccine. 2014 May 19;32(24):2878-81.

❖Rivesh T, Balamurugan V, Sen A, Bhanuprakash V, Venkatesan G, Yadav V, Singh RK. Evaluation of **efficacy of stabilizers** on the thermostability of live attenuated thermo-adapted **Peste des petits ruminants** vaccines. Virol Sin. 2011 Oct;26(5):324-37.

❖Silva AC, Carrondo MJ, Alves PM. **Strategies for improved stability** of **Peste des Petits Ruminants** Vaccine. Vaccine. 2011 Jul 12;29(31):4983-91.

❖Sarkar J, Sreenivasa BP, Singh RP, Dhar P, Bandyopadhyay SK. Comparative **efficacy of various chemical stabilizers** on the thermostability of a live-attenuated **peste des petits ruminants** (PPR) vaccine. Vaccine. 2003 Dec 1;21(32):4718-35.

17

Thermal stability of vaccine

Efficacy of various chemical stabilizers on the thermostability of a live-attenuated *peste des petits ruminants* (PPR) vaccine

❖Trehalose dihydrate (TD), lactalbumin hydrolysate–sucrose (LS) as stabilizer for lyophilization, Tris/trehalose also used

❖Addition of 25 mM fructose resulted in a higher virus production (1 log increase) with higher stability (2.6-fold increase compared to glucose 25 mM) at 37°C.

❖Increased concentrations of NaCl, improved virus release, reducing the cell-associated fraction of the virus produced.

❖Strains: PPR Sungri/96, Nigeria 75/1 propagated on Vero cells

❖Similar studies have to be carried out for recombinant vaccines.

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3.2 Seroprevalence of PPR in Sheep and Goats of selected Districts of Semiarid Rajasthan

G.G. Sonawane, S.C. Dubey and R.K. Singh
Central Sheep and Wool Research Institute, Avikanagar, Rajasthan 304501

Among all the livestock species, small ruminant population is the major capital of animal holders in Rajasthan state. However, systematic epidemiological information about status of economically important diseases of sheep and goats including PPR disease is not available. In the present study, an attempt was made during 2003-2005 to assess the prevalence of PPR in sheep and goats in semiarid districts of the state.

A total of 2380 blood samples (sheep-1222, goat-1158) was collected from selected five districts. Of these, 982 (sheep-502, goat-480) serum samples were randomly selected and tested using c-ELISA kit. 132 sheep and 68 goat serum samples from CSWRI, Avikanagar and 279 sheep samples from large scale Sheep Breeding Farm (LSSBF), Fatehpur, Rajasthan were also included in the study to observe sero-prevalence at farm level.

Testing revealed an overall prevalence of 55.37% of PPR in field sheep, 55.41% in field goats, 22.37% in farm sheep and 25.75% in farm goats. Combined overall prevalence in small ruminant population in field was 55.39% and in farm was 21.71%. Surveillance data of field and farm flocks also indicated more than double sero conversion in field flocks (55.39%) in comparison to farm flocks (21.71%). Such a wide gap in sero conversion resulted in a positive and effective role of farm management helpful in limiting spread of a PPR like contagious disease. There were variations in the seroprevalence from breed to breed and from district to district. In Rajasthan, seroprevalence was high in sheep as compared to that in goats, thereby indicating risk of high exposure of sheep to the disease.

On the basis of the present study, it can be concluded that prevalence of PPR is higher in local sheep and goats without frank clinical disease in the area, indicating a possibility of regular circulation of PPR virus in sub-acute form in this area. Hence, early diagnosis and early vaccination will be very helpful in controlling the disease. Effective PPR vaccination strategy at CSWRI farm and in the field area, after availability of commercial vaccine was found beneficial in prevention of entry of such a fatal disease and in curtailing losses occurring due to heavy mortality.

Please find the detailed information as given below:


www.cswri.res.in
Seroprevalence of PPR in sheep and goats of selected districts of semiarid Rajasthan
By
G.G. Sonawane, Sr. Scientist, ICAR-CSWRI, Avikanagar
S. C. Dubey, Ex. Joint Director, ICAR-HSADL, Bhopal
R. K. Singh, Director, ICAR-IVRI, Izatnagar, Bareilly
Research
HRD
Transfer of Technology
CSWRI

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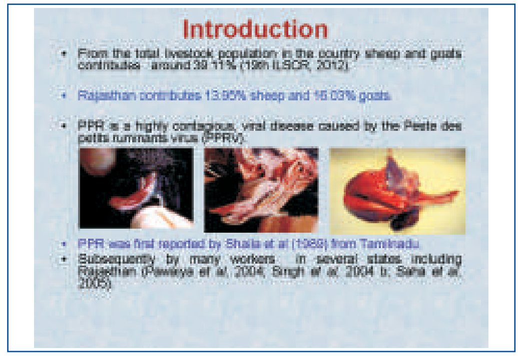
Introduction
From the total livestock population in the country sheep and goats contributes around 39.11% (19th ILSCR, 2012)
Rajasthan contributes 13.95% sheep and 16.03% goats.
PPR is a highly contagious, viral disease caused by the Peste des petits ruminants virus (PPRV).
PPR was first reported by Shaila et al (1989) from Tamilnadu.
Subsequently by many workers in several states including Rajasthan (Pawaiya et al. 2004; Singh et al. 2004 b; Sana et al. 2005).

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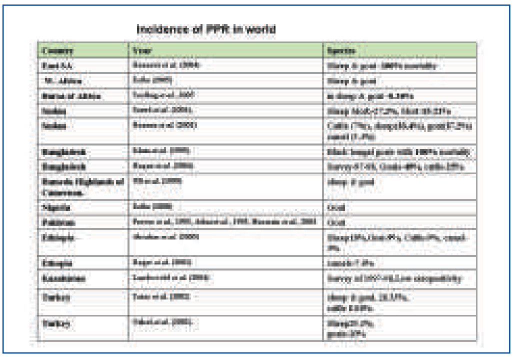
Incidence of PPR in world
Country
Year
Species

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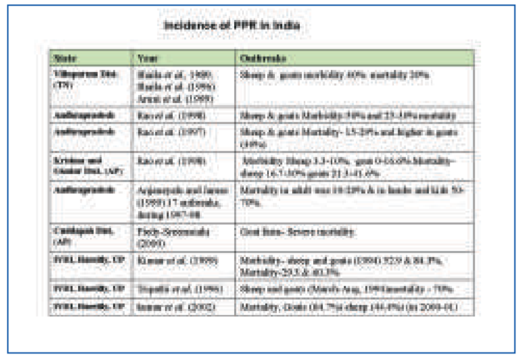
Incidence of PPR in India
State
Year
Outbreaks

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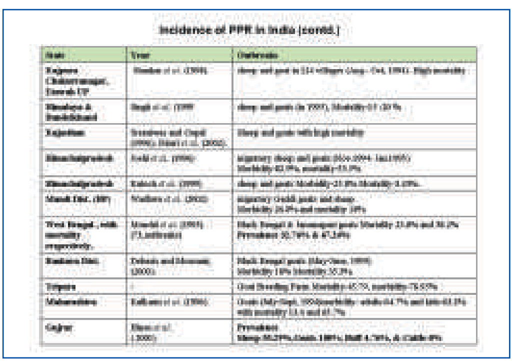
Incidence of PPR in India (contd.)
State
Year
Outbreaks

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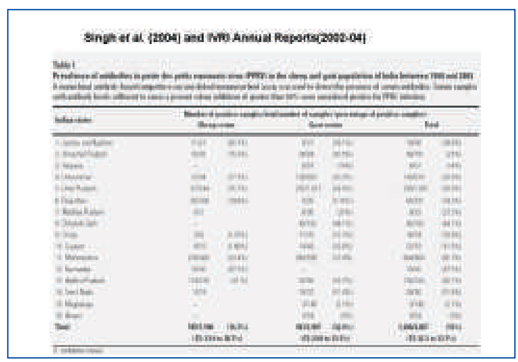
Singh et al. (2004) and IVRI Annual Reports(2002-04)
Table I

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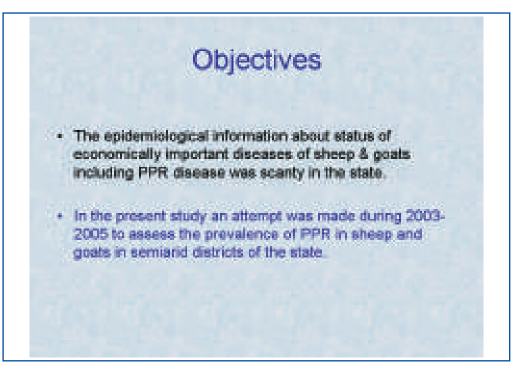
Objectives
The epidemiological information about status of economically important diseases of sheep & goats including PPR disease was scanty in the state.
In the present study an attempt was made during 2003-2005 to assess the prevalence of PPR in sheep and goats in semiarid districts of the state.

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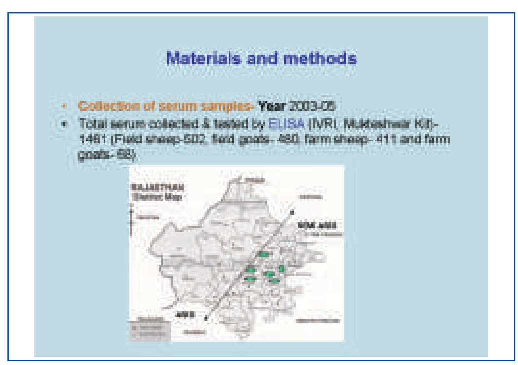
Materials and methods
Collection of serum samples- Year 2003-05
Total serum collected & tested by ELISA (IVRI, Mukteshwar Kit)- 1461 (Field sheep-502, field goats- 480, farm sheep- 411 and farm goats- 68)
RAJASTHAN
District Map

8

Results

PPR seroprevalence in farm flocks

Avikanagar Sheep			Avikanagar Goats			LSRRF, PATHIPURA Sheep		
Breed	ST	SP (%)	Breed	ST	SP (%)	Breed	ST	SP (%)
Bharat Merino (BM)	42	11 (35.7)	Sirohi	68	17 (25)	Exotic	120	39 (36.46)
Avikalin (GC)	40	10 (36.7)				75% Cross	110	13 (12.26)
Malpura x Garole (MG)	11	01 (9.09)				50% Cross	45	01 (2.22)
Malpura	50	00 (0.0)						
Total	132	34(25.75)		68	17(25)		270	53(19.99)
Over all	479/104 (21.71)							

ST/SP=Sample collected/sample tested/sample positive

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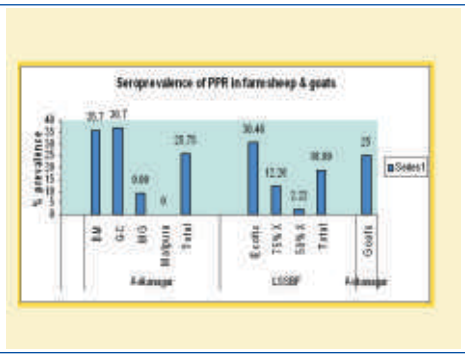

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PPR seroprevalence in field flocks

Sr. No.	Districts	Sheep		Goats	
		ST	SP (%)	ST	SP (%)
1	Tonk	103	68 (66.01)	78	46 (58.97)
2	Ajmer	93	67 (72.04)	69	37 (53.62)
3	Jaipur /Sawai Madhapur	123	78 (64.40)	114	60 (52.63)
4	Bundi	102	31(30.39)	111	62 (55.85)
5	Bhilwara	83	34 (40.96)	108	61 (56.48)
	Total	502	278 (55.37)	480	266 (55.41)
	Total (Sheep + Goat)	982 / 544 (55.39)			

ST/SP=Sample collected/sample tested/sample positive

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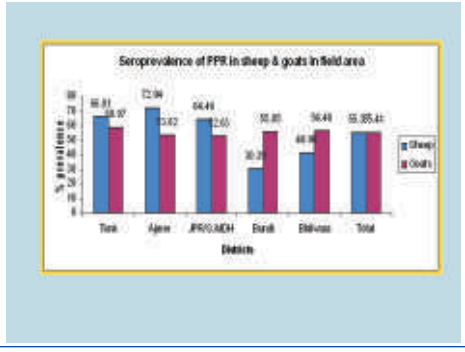

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Conclusions

- Seroprevalence on overall average basis in goat and sheep (55.41% and 55.37% respectively) indicates equal chances of exposure of both the species to circulating virus.
- The PPR prevalence in the field (55.39%) sheep and goats is higher than the prevalence of farm (21.71%) sheep and goats.
- In the present report prevalence of PPR is higher in local sheep and goats without frank clinical disease indicating a possibility of regular circulation of PPR virus in sub-clinical form.

13

Acknowledgements

Authors are thankful to the
- Director CSWRI, Avikanagar for infrastructure facilities.
- Various officers of the state A.H. Departments of Rajasthan
- Technical officers and other supporting staff of CSWRI, Avikanagar.

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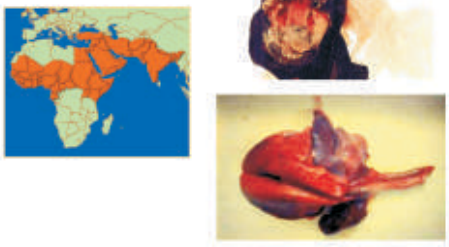

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16

3.3 PPR Control in India and the Role of Hester

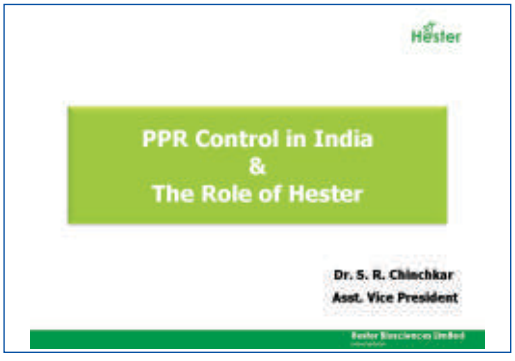
S.R. Chinchkar
Hester Biosciences Ltd., Ahmedabad 380006

Peste des Petits Ruminants (PPR) is a contagious viral disease and has high economic importance. The eradication of Rinderpest disease has resulted in a milestone for control of disease through vaccination. In India, IVRI developed PPR vaccine (Sungri-96) which has shown remarkable impact on control of PPR disease in the country. The same technology was adopted by Hester Biosciences to commercialise PPR vaccine.

Hester is also in the process of developing the vaccine which can be stable at 40^0C on the 10th day. Using $MgCl_2$ as a dilutant helped in vaccine stability at higher temperature in the field. Production of thermo adapted PPR vaccine has good advantage of having longer life in the field conditions. A comparative study between sub-cutical vaccine vis-à-vis intranasal vaccine has confirmed that both these vaccines are equally effective.

To control PPR disease, the vaccine needs to be applied to all susceptible population. Vaccination in December-January will be very effective. Deworming prior to vaccination will be very effective in December-February. Synchronising vaccination with time of migration of sheep will easily help in covering migratory animals. While implementing the vaccination campaign, certain practical problems like availability of vaccine on time and in sufficient quantity, maintenance of cold chain till its use and vaccination within defined time frame with available resources need to be addressed.

Please find the detailed information as given below:



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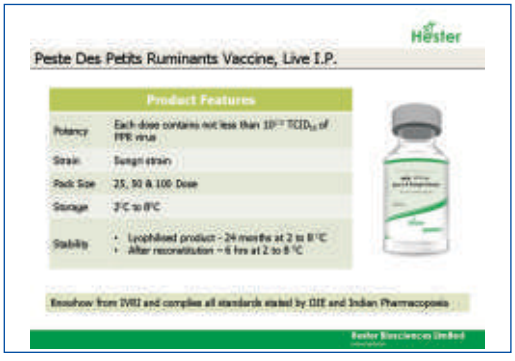
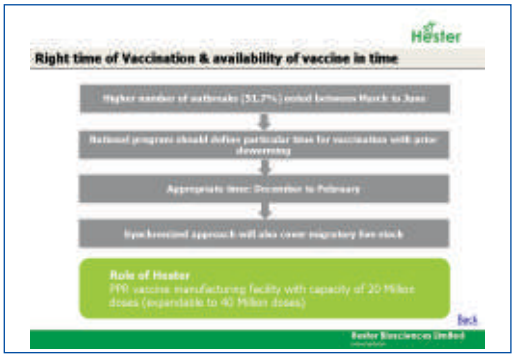


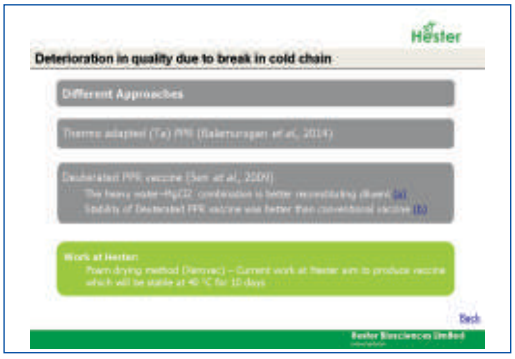
2


National Control Programme of PPR – Expected challenges
Right time of Vaccination & availability of vaccine in time
Deterioration in quality due to break in cold chain
Mass vaccination with available resources & Control on vaccination cost

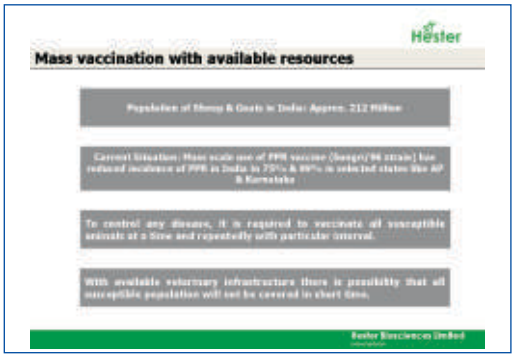
3


Right time of Vaccination & availability of vaccine in time
Role of Hester
PPR vaccine manufacturing facility with capacity of 20 Million doses (expandable to 40 Million doses)

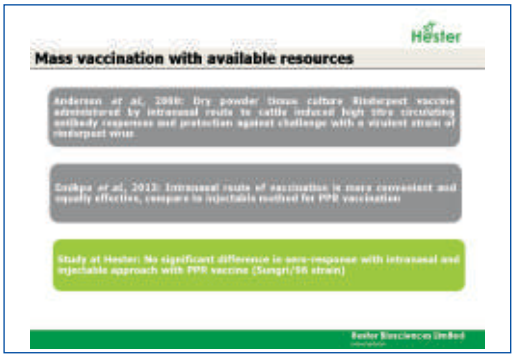
4


Deterioration in quality due to break in cold chain
Different Approaches

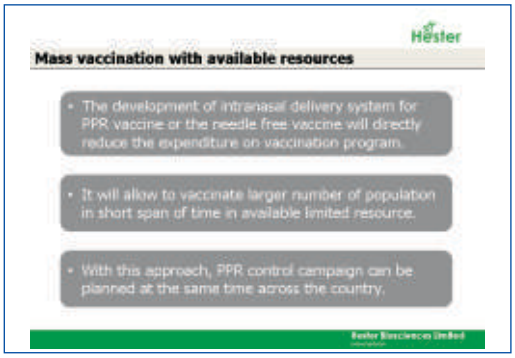
5


Mass vaccination with available resources

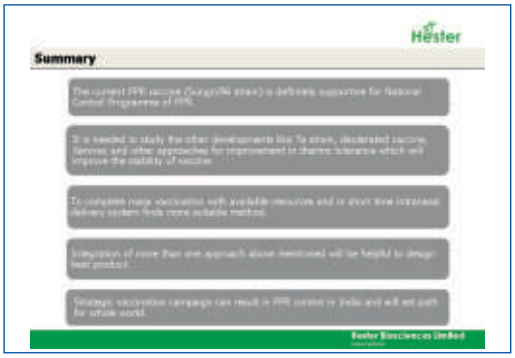
6


Mass vaccination with available resources

7


Mass vaccination with available resources
The development of intranasal delivery system for PPR vaccine or the needle free vaccine will directly reduce the expenditure on vaccination program.
It will allow to vaccinate larger number of population in short span of time in available limited resource.
With this approach, PPR control campaign can be planned at the same time across the country.

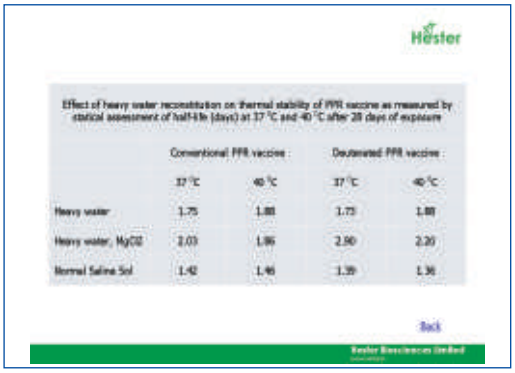
8


Summary

9


Healthy Livestock
for
Wealthy Country

10



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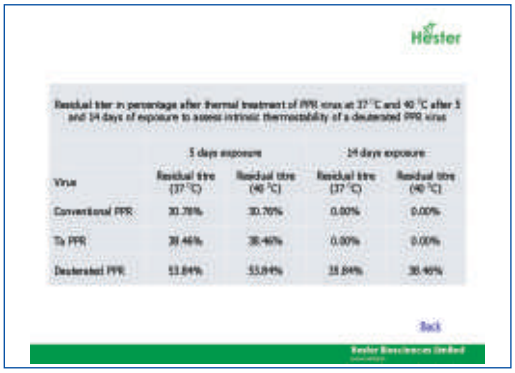


12

3.4 *Peste des Petits Ruminants* - Disease and its Control in India

K. Srinivas

Indian Immunologicals Ltd., Hyderabad 500032

Peste des Petits Ruminants (PPR) continues to be one of the major viral diseases affecting huge susceptible small ruminant population in India. Small ruminants significantly contribute to the rural economy as these species are considered to be a poor man's cow providing financial stability. Nonetheless, the disease is known to have devastating consequences in epidemics resulting in heavy mortalities. Quality vaccines are available that can be used throughout the world irrespective of the lineage in offering very strong vaccine induced immunity in mass vaccination control campaigns. Restriction on movement of animal and quarantine apart from disinfection of the sheds are equally important. Early reporting and timely vaccination and mass vaccination should cover 85% of the population. Indian Immunologicals Ltd, a leading manufacturer of veterinary vaccines in Asia continues to lead the fight against the control of important diseases of livestock in India in collaboration with various Government agencies and International collaborators to realize the dreams for better economic standards of rural poor farmers. The following presentation summarizes the nature of the disease and the control strategy for PPR.

Please find the detailed information as given below:

Peste des Petits Ruminants – PPR

DISEASE AND ITS CONTROL IN INDIA

Indian Immunologicals Limited
Hyderabad

1

PESTE DES PETITIS RUMINANTS – PPR

*Introduction/Prevalence
*Disease
*Financial significance
*Control
*PPR vaccines

2

PREVALENCE OF PPR – WORLD

Map of PPR geographical distribution (FAO 2009)

OIE listed - A Disease due to high morbidity, mortality, high contagious nature and severe economic impact it has on world's livestock population – small ruminants

Important trans boundary viral disease. Marked areas are with PPR reported prevalence . FAO estimates 62.5% of world's small ruminant popln. at risk.

3

PREVALENCE OF PPR – INDIA

*First identified in Ivory Coast in 1942
*In India – first case was confirmed from Arasur, Vilupuram district in Tamil Nadu (Shaila et al 1987)
*From northern states- in 1996 by Nanda et al

*Shaila, M.S., Purushothaman, V., Bhavasar, D., Venugopal, K. and Venkatesan, R.A. (1989) Peste des petits ruminants of sheep in India. Vet. Rec., 125: 602.
*Nanda YP, Chatterjee A, Purohit AK, Diallo A, Janni K, Sharma RN, Libeau G, Thevasagayam JA, Bruning A, Kitching RP, Anderson J, Barrett T & Taylor WP (1996) : The isolation of Peste des petits ruminant virus from North India, Vet. Microbiol. , 51 (3-4), 207-216.

4

PREVALENCE OF PPR - INDIA

*The Disease is endemic in the country and maximum cases are seen from March to June - Maximum reported outbreaks from south and south western parts of the country.
*Incidence is highest in young animals (< 6 m), followed by 6 to 12 months and less in adults (> 1 yr age.

5

PPR – SMALL RUMINANTS

***Significant population of sheep and goats in Asia**
> 390 million goats and > 250 million sheep – Asia
***57% & 23 % of world's goat and sheep population in Asia**
***Of which 55% and 39% of goats and sheep are found in India, China and Pakistan**
***India > 200 millions**
***Known for their contribution towards milk, meat, fiber and skin. Considered to be a poor man's cow in developing countries**
***With porous borders, control becomes difficult**

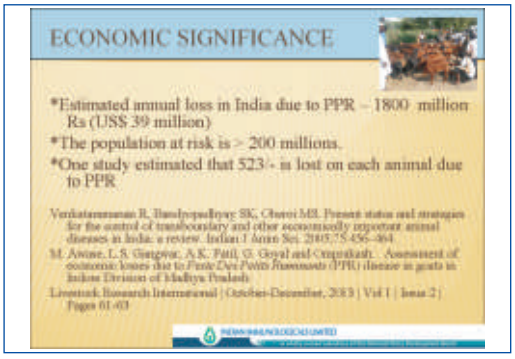
6

THE DISEASE

*High fever,
*Watery nasal discharge progressing to profuse muco-purulent discharge with catarrhal exudate occluding the nostrils
*Inflammation of the gastro-intestinal tract leading to necrosis and ulceration of the mucous membrane
*Diarrhea

7

8



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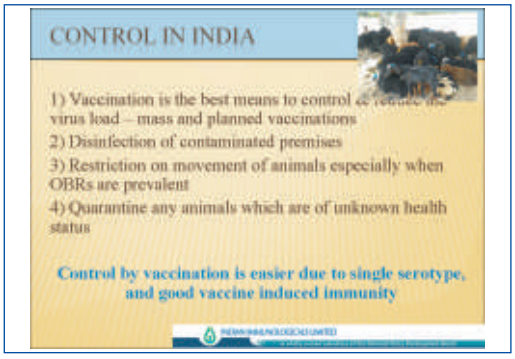

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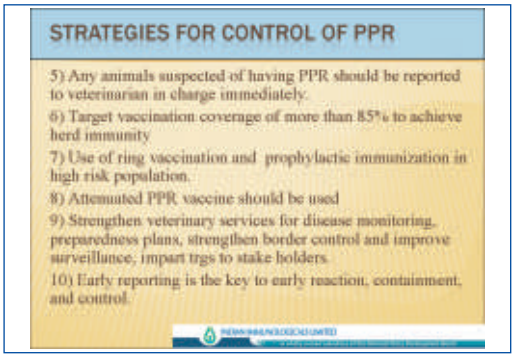

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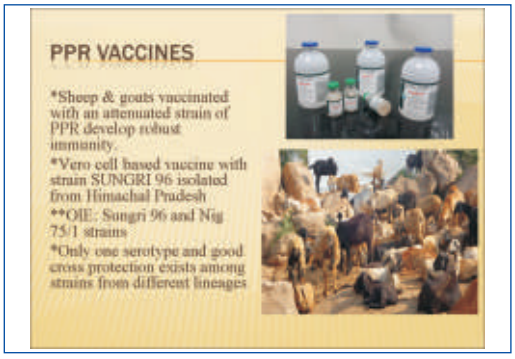


12

3.5 Mass Vaccination for prevention of PPR Disease on the lines of Pulse Polio Campaign - Experiences from Chhattisgarh

Goutam Roy, Neetu Gordiya, D.K. Siyar and S.K. Pandey
Directorate of Veterinary Services, New Raipur 492001, Chhattisgarh

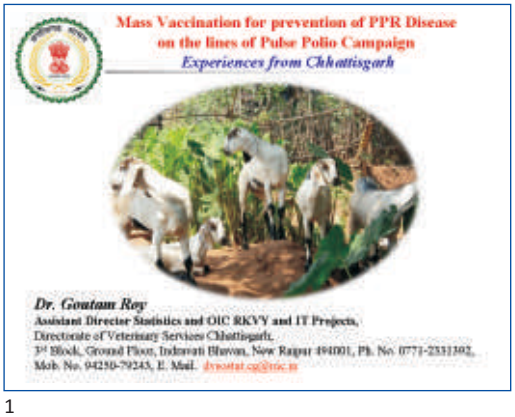
Agriculture in Chhattisgarh is dominated by the small land holders and the landless. Of 3.6 million rural households in the state, about 18% are landless, 24% are sub-marginal and 19.5% are marginal. Chhattisgarh is very rich in livestock wealth with 1.50 crore animals (excluding poultry) as per 19th Livestock Census 2012, against 2.55 crore human population, as per Human Census 2011. There are 1.66 lakh sheep and 32.25 lakh goats in the state. The average annual growth rate of small ruminants has shown a steep rise in past 5 years. Goat husbandry is characterized by low inputs in feeding, breeding and housing with higher return in terms of meat output. It is more gender equitable and easily managed among domestic livestock species. Goat also has special browsing ability and does not compete with large ruminants for feed.

PPR is a major threat causing heavy economic loss for the goat and sheep keepers in Chhattisgarh since the past decade. The disease occurs as epizootics and cases go largely

undetected due to unavailability of efficient diagnostic infrastructure in the state. Poor people are the silent sufferers. The total asset value of goats in the state can be projected to be around Rs. 1186 crores. Assuming an annual loss of 5% animals due to PPR disease (directly caused by disease and indirectly by distress selling in the event of disease incidence in the village), the economic losses alone works out to be more than Rs.59 crores annually. Thus, it is evident that if PPR disease is controlled effectively it will have direct and significant impact on the producers as well as consumers in the state.

For controlling PPR disease, a programme was undertaken in 2012-13, under Rashtriya Krishi Vikas Yojana (RKVY). Field Technical team created awareness and training of junior staff, and farmers, by involving the Village Sarpanchs (Heads of the local Government) on the PPR control, through mass publicity media such as television, radio programmes, intensive publicity through advertisement on Doordarshan and private channels for 15 times in a day. This was followed by mass vaccination carried out in 12 days, involving all the departmental staff. Vaccination was carried out at goat markets, check posts in the city and state borders. Wall writing on individual houses who participated in the vaccination could help to follow up farmers who were not covered under the vaccination programme. Vaccination reporting was done everyday at the state headquarters. Incentive for vaccination was given to paravets. Follow up vaccination was done in the villages where missed vaccination was carried out. During 2012-13, 26.25 lakh vaccinations were carried out and 28.89 lakhs in 2013-14 covering 80% animals. Budget utilised was around Rs. 17 crores. Serum sample was taken of 0.01% animals to identify the level of antibody level. As a result of vaccination, in the years 2009-10, 2010-11 and 2011-12, only one case of outbreak was reported while there were no incidences of PPR in the state during 2013-14.

Please find the detailed information as given below:



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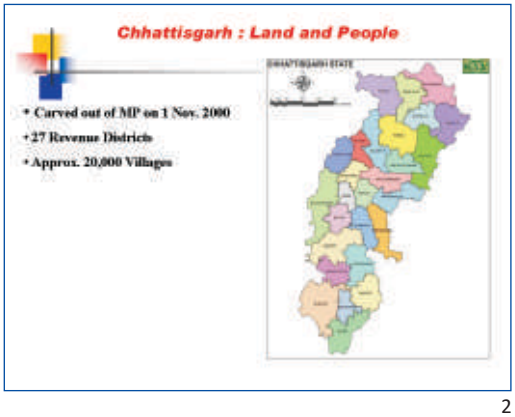


2

Chhattisgarh : Land and People

- Carved out of MP on 1 Nov. 2000
- 27 Revenue Districts
- Approx. 20,000 Villages
- Total Forest Cover: 63.36 Lakh Ha (46%)
- Net Sown Area: 47.75 Lakh Ha (35%)
- Average Annual Rainfall: 1351 mm

3

Chhattisgarh : Land and People

- Carved out of MP on 1 Nov. 2000
- 27 Revenue Districts
- Approx. 20,000 Villages
- Total Forest Cover: 63.36 Lakh Ha (46%)
- Net Sown Area: 47.75 Lakh Ha (35%)
- Average Annual Rainfall: 1351 mm
- 2.55 Cr. Human Population (2011 Census)
- Average Annual Population Growth: 2.2%
- 12% SC and 32% ST Population
- 37.46 Lakh Farm Families out of 56.51 Lakh Families

4

Chhattisgarh : Livestock Demographics

19th Livestock Census 2012

Livestock Species	Sheep and Goat Population (Lakh Numbers)						
	1997	2003	% Change	2007	% Change	2012	% Change
Goat	21.54	23.35	8.4	26.68	14.26	32.25	20.87
Sheep	1.95	1.21	-38.1	1.40	15.70	1.66	18.57
Total	23.49	24.56	4.55 %	28.08	14.33 %	33.91	20.76 %

Challenge is how to reach out to 33.93 Lakh Animals that are reared by 6.30 Lakh Household spread out in 20, 000 villages of 27 Districts covering 135 Lakh Hectares of Land

Project : State Wide PPR Disease Control

ASCAD
Assistance to States for Control of Animal Diseases

→ **Provision for**
1.Vaccines
2.Consumables

RKVY
Rashtriya Krishi Vikas Yojana

→ **Provision for**
1.Training before every campaign
2.Mobility for Monitoring, Delivery of Vaccine, Consumables and Ice.
3.Honorarium for Non Govt. Vaccinators (Gaurakshi) About 40% of the total Work Forc
4.Publicity through Newspaper and Television
5.Testing of Serum Samples

5

Project : State Wide PPR Disease Control

1. Pre Vaccination Phase:

1.Annual Pre Vaccination Campaign Training (State and District Level)
2.Preparation and distribution of Monitoring Formats, Letters to All Sarpanchs by Agriculture Minister, setting up of Control Rooms.
3.Mass Awareness Campaign by Newspaper and TV advertisement. TV Advertisement in one Private Channel and Doordarshan (since 2012-13), about 15 times per day, in Different time slots.
4.Procurement of vaccines, ice and consumables
5.Collection of serum samples of about 0.01% of unvaccinated goats 1 month before vaccination.

7

Project : State Wide PPR Disease Control

1. Pre Vaccination Phase:

8

Project : State Wide PPR Disease Control

2. Vaccination Phase:

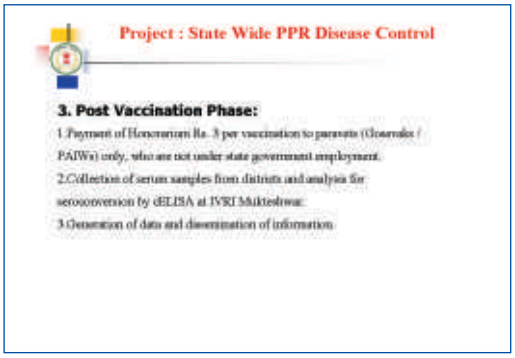
1.Mass Vaccination Campaign – Continuous vaccination work for 10-12 days.
2.Wall Writing for Labeling Households.
3.Daily monitoring of events through control rooms at District and State.
4.Vaccination at all known goat markets, farms, nomadic units and selling units.
5.Vaccination at Check Posts (State Borders).
6.Emergency Vaccination – In the face of Suspected Disease Incidence (if any).
7.Vaccination at Villages missed out during the campaign.

9

Project : State Wide PPR Disease Control

2. Vaccination Phase:

10



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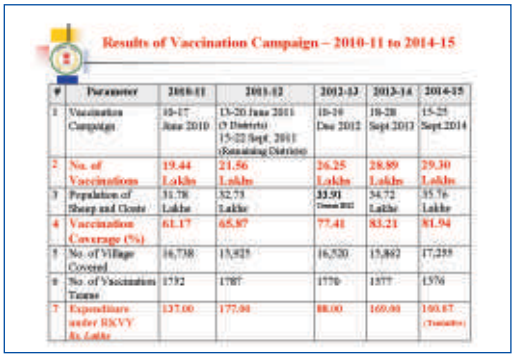
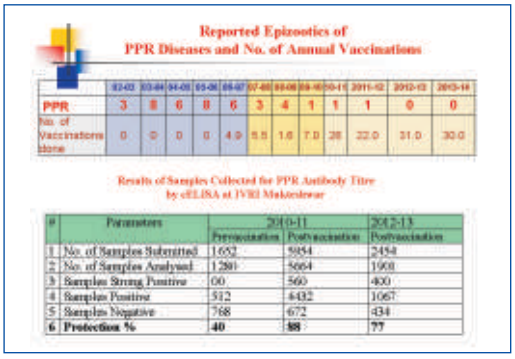


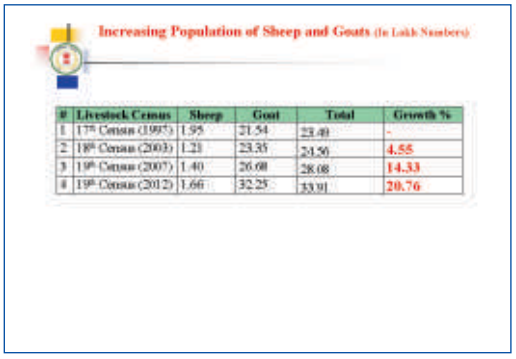
#	Parameter	2010-11	2011-12	2012-13	2013-14	2014-15
1	Vaccination Campaign	10-17 June 2010	15-20 June 2011 (9 Districts) 15-22 Sept. 2011 (Remaining Districts)	10-16 Dec 2012	10-28 Sept 2013	15-25 Sept 2014
2	No. of Vaccinations	19.44 Lakhs	21.56 Lakhs	26.25 Lakhs	28.89 Lakhs	29.30 Lakhs
3	Population of Sheep and Goats	31.78 Lakhs	32.75 Lakhs	33.91	34.72 Lakhs	35.76 Lakhs
4	Vaccination Coverage (%)	61.17	65.87	77.41	83.21	81.94
5	No. of Village Covered	16,738	15,925	16,920	15,862	17,255
6	No. of Vaccination Teams	1592	1787	1770	1377	1576
7	Expenditure under RKVY Rs.Lakhs	137.00	177.04	88.00	160.00	160.87

12



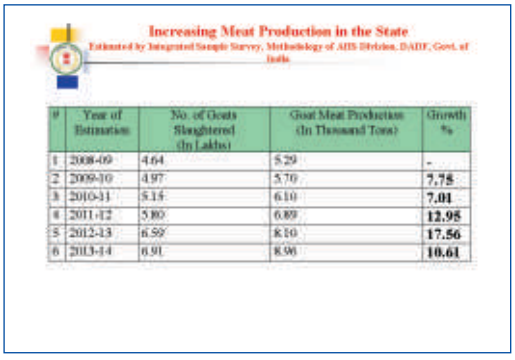
#	Parameters	2010-11 Pre-vaccination	2010-11 Post-vaccination	2012-13 Post-vaccination
1	No. of Samples Submitted	1652	5854	2454
2	No. of Samples Analysed	1280	5664	1908
3	Samples Strong Positive	00	560	400
4	Samples Positive	512	4432	1067
5	Samples Negative	768	672	434
6	Protection %	40	88	77

13



#	Livestock Census	Sheep	Goat	Total	Growth %
1	17th Census (1997)	1.95	21.54	23.49	-
2	18th Census (2003)	1.21	23.35	24.56	4.55
3	19th Census (2007)	1.40	26.68	28.08	14.33
4	19th Census (2012)	1.66	32.25	33.91	20.76

14



#	Year of Estimation	No. of Goats Slaughtered (In Lakhs)	Goat Meat Production (In Thousand Tons)	Growth %
1	2008-09	4.64	5.29	-
2	2009-10	4.97	5.70	7.75
3	2010-11	5.15	6.10	7.01
4	2011-12	5.80	6.89	12.95
5	2012-13	6.59	8.10	17.56
6	2013-14	6.91	8.96	10.61

15

16

3.6 Development of Vaccine for PPR: A Disease of Small Ruminants

S.N. Singh

Biovet Pvt Ltd, #308, 3rd Phase, KIADB Industrial Area, Malur, District Kolar, Karnataka

Peste des Petits Ruminants (PPR) also known as ovine Rinderpest, is a contagious disease affecting goats and sheep. It is also known as sheep and goat plague. It causes mortality in more than 50% of the affected animals due to high fever, pneumonia, diarrhoea and dehydration. As per ICAR reports, the annual loss due to PPR in small ruminants (about 200 million) is approximately Rs. 180 crores.

Due to the immense economic impact of PPR, measuring the clinical prevalence of PPR in different geographical areas of the country with varying agro-climatic conditions, may be helpful in establishing disease control strategies and for determining the actual infection rate. With respect to differential diagnosis, we should have facilities for different diagnosis to make sure there is effective disease control.

An effective vero-cell line based live attenuated indigenous freeze-dried vaccine has been developed by ICAR and validated using extensive field trials. The vaccine has a shelf life of more than one year at 4^{0}C and provides immunity for three years. The vaccine is safe, potent and acceptable for use in sheep and goat population. The vaccine is now being produced in several states including Andhra Pradesh, Maharashtra, West Bengal, Haryana and Karnataka.

Indian Institute of Science, Bangalore, had developed an edible PPR vaccine in 2004, which is undergoing field trial. The Tamil Nadu Veterinary and Animal Sciences University is also working on the development of PPR vaccine. A thermo-stable vaccine is also being developed to avoid cold chain in field condition. Oral pillet vaccine can also be explored like in the case of poultry for New Castle vaccine. Use of marker vaccine (DIVA) will help in effective monitoring and control of the disease. A prompt system for quality vaccine delivery under cold chain at the grassroot level with trained vets, paravets and farmers will certainly help to control this disease. Disinfection of premises is necessary and the most common disinfectant used is alkaline solution (sodium carbonate/hydroxide) followed by Halogens (sodium hypochlorite), Phenolic compounds, citric Acid, alcohols and iodophores.

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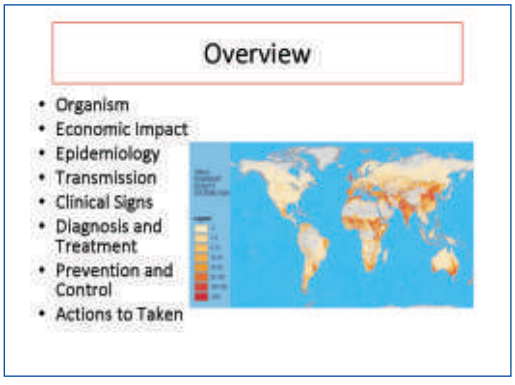
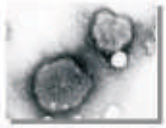


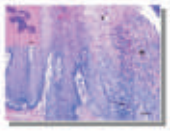
2

Pest des Petits Ruminants virus (PPRV)

- Family Paramyxoviridae
- Genus *Morbillivirus*
- Closely related to rinderpest virus
  - Very similar antigenically
  - Antibodies arecross-protective
  - Viruses are distinct

A provost and A Diallo : Cote d'Ivoire in West Africa 1942





3

Economic Impact

- Presence of disease can limit:
  - Trade and export
  - Import of new breeds
  - Development of intensive livestock production
- Loss of animal protein for human consumption
- loss due to PPR in India is 170.2 CR per year.
- mortality 70 to 80 % in 10-12 days.

4

Species Affected

- Principally goats and sheep
- Cattle and pigs seroconvert but do not develop or transmit disease
- Wild ungulates can be affected
  - Gazelle, deer, ibex, gemsbok
  - Limited information on species susceptibility, occurrence of disease

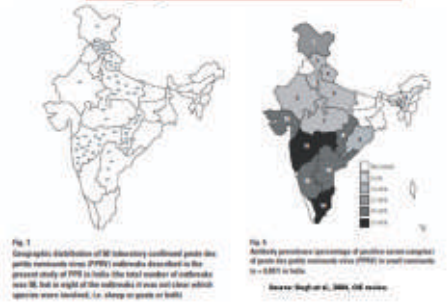
5

Geographic Distribution

- Africa
  - South of the Sahara
  - North of the equator
- Middle East
- Parts of Asia
  - Indian subcontinent
  - First reported by Shaila et. al., 1987 from Arasur village in Tamil Nadu, South India .
  - It is now prevalent in all the parts of the country.
  - Nanda *et al, 1996 reported in* Northern India.

6

Geographical Distribution in India...



7

Morbidity and Mortality

- Young animals most affected
  - Ages 2 months to 2 years
- Varies by species, immunity, breed
- Morbidity and mortality rates
  - Up to 100% in naive herds
  - Lower in endemic areas
- High case fatality rate
  - Exotic ungulates

8

Transmission

- Close contact, inhalation
- Virus shed in nasal and ocular secretions, saliva, urine, and feces
- Long-term carriers unlikely
- Role of fomites unclear
  - Do not remain infectious for long

9

Clinical Signs

- Incubation period
  - 2 to 10 days
- Peracute
- Acute
  - High fever
  - Serous nasal, ocular discharge becomes mucopurulent
  - Hyperemic gums, necrotic oral lesions

10

Clinical Signs

- Profuse diarrhea
  - Dehydration
  - Emaciation
- Rapid respiration, dyspnea
- Abortion
- Skin nodules around muzzle
- Subacute, asymptomatic disease

11

Post Mortem Lesions

- Inflammatory and necrotic lesions
  - Oral cavity
  - GI tract
- Emaciation
- Erosive lesions "zebra stripes"
- Bronchopneumonia
- Enlarged lymph nodes

12

Clinical Diagnosis

- PPR should be considered in:
  - Sheep, goats, or gazelle
  - Acutely febrile, highly contagious disease
  - Oral or GI signs

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Differential Diagnosis

- Rinderpest
- Bluetongue
- Contagious ecthyma
- Foot and mouth disease
- Heartwater
- Coccidiosis
- Mineral poisoning
- Contagious caprine pleuropneumonia
- Pasteurellosis

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Laboratory Diagnosis

- Virus isolation
- Antigen detection
- RT-PCR
- Serology
- Samples
  - Discharges, oral lesions, whole blood

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Prevention by Vaccination only

- No specific treatment only symptomatic
- Drugs to control bacterial and parasitic complications
  - May decrease mortality
- Supportive care
- Biosecurity
- Quarantine
- Movement controls
- Euthanasia of infected and exposed animals
- Cleaning and disinfection of infected premises

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Vaccination

- Outbreaks
  - Ring vaccination, high-risk populations
- Endemic areas
  - Used to control disease
- Vaccine types
  - Homologous, attenuated PPR vaccine
  - Thermo-stable PPR vaccine
  - Recombinant vaccine (H&F gene)
  - Marker/DIVA vaccine and complementary diagnostics
  - India launched national PPR control program under DAHDF, GOI.

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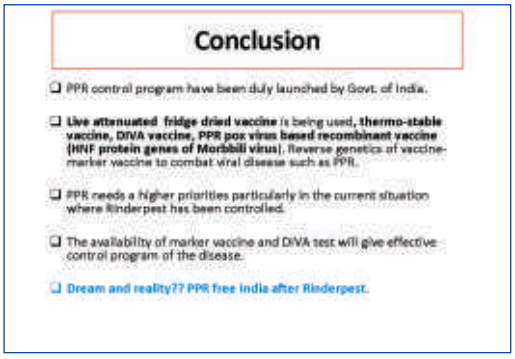
Disinfection for on farm management

- PPR virus killed by most common disinfectants
  - Alkalis (sodium carbonate, hydroxide)
  - Halogens (sodium hypochlorite)
    - 2% for 24 hours
  - Phenolic compounds
  - Citric Acid
  - Alcohols
  - Iodophores

Indian Village farming...

18



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Chairman's Remarks

Although PPR is the most serious disease of small ruminants, the disease outbreaks are not being reported correctly due to poor communication network and pressure from senior officials. Proper recording of disease outbreaks and their socio-economic impact should be documented for correct assessment of the damage. Awareness among farmers about the disease, seasons of outbreak, availability of vaccine, quarantining newly brought animals and segregation of suspected animals should be created. A toll free number may be assigned for direct reporting about the disease outbreak by the farmers to a State Agency to ensure timely reporting and action.

Early diagnosis in the field will be beneficial. This can be followed by Ring vaccination to cordon off the infected area. Considering major outbreaks in April-June, vaccination in December-February is recommended. Vaccinating in winter will help in preventing damage to vaccine during its use in the field. Targetted mass vaccination consecutively for 2-3 years, covering all unvaccinated sheep and goats in A.P., Karnataka, Chhattisgarh and Rajasthan has been effective in controlling the disease significantly. Vaccinations should cover kids in the age group of 3 months and above all, the unvaccinated animals. Deworming prior to vaccination is desirable. Animal registration card including health and vaccination details will be helpful for effective monitoring. ■

TECHNICAL SESSION 4:
Strategies for PPR Control in India

Chairman: Mr. Sanjay Bhoosreddy

Jt. Secretary, Administration and National Livestock Mission (ANLM),
DADF, Government of India

Co-Chair: Dr. Hameed Nuru, GALVmed

Senior Director, Policy & External Affairs, GALVmed, Gaborone Botswana

4.1 PPR Control and Eradication

Satya Parida
The Pirbright Institute, U. K.

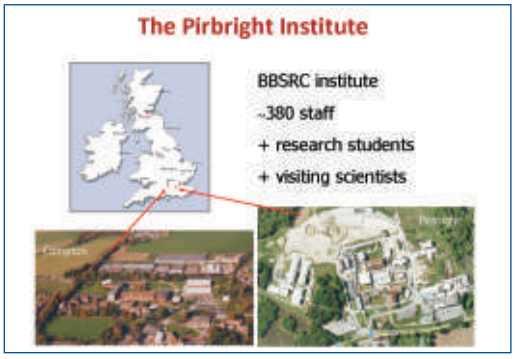
The target date set by OIE and FAO for global eradication of PPR is 2030. The strategy is to understand epidemiology and ecology in the context of farming system, prepare a road map and monitor the vaccination with efficient attenuated and DIVA vaccine combination with campaign marked with deworming. The impact of the disease are direct death, loss of production, expenses towards diagnosis and treatment, and distress sale. There are four lineages in the PPR virus and the vaccine will protect all four of them. For successful eradication of disease, early diagnosis and vaccination with live attenuated vaccine can be effective. The difficulties involved were poor infrastructure and political will, poor laboratory conditions, presence of mild disease in wildlife reservoirs and ability to differentiate between vaccinated and naturally infected animals.

With regard to PPR control, the case study of Andhra Pradesh, on disease outbreak, follow up of vaccination and subsequent impact clearly focussed on the strategy of mass vaccination followed by strong surveillance. Multivalent vaccine can provide life-long immunity. An important strategy which may be considered for eradication of the disease is maximum coverage through mass vaccination using a well-planned strategy for awareness, thorough education of disease symptoms and control, followed by vaccination to cover uncovered animals particularly in border areas, using vaccine certificate for migrating flocks, good disease monitoring system and sero-surveillance of vaccinated animals, including the kids of four months.

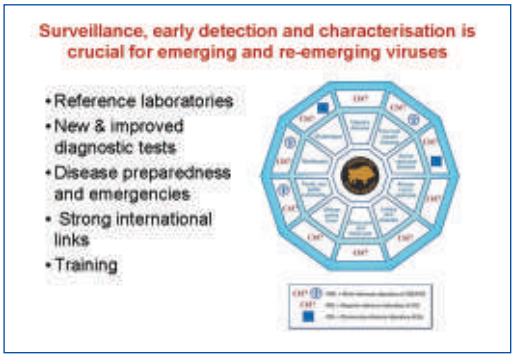
Please find the detailed information as given below:


Pirbright
PPR control and eradication
Satya Parida
The Pirbright Institute,
Murdoch
BBSRC
NIAB
Oxford University
www.pirbright.ac.uk

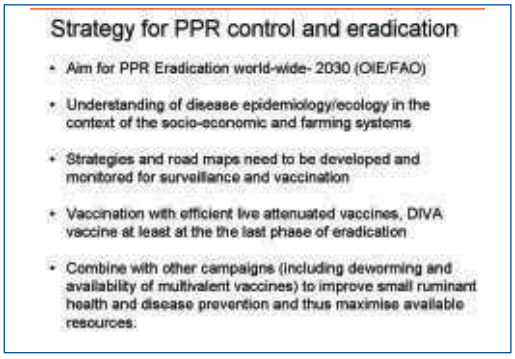
1


The Pirbright Institute
BBSRC institute
~380 staff
+ research students
+ visiting scientists

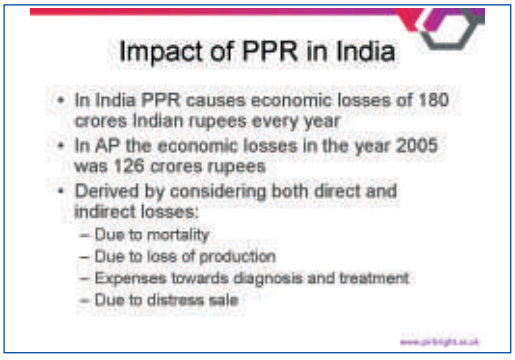
2


Surveillance, early detection and characterisation is crucial for emerging and re-emerging viruses
•Reference laboratories
•New & improved diagnostic tests
•Disease preparedness and emergencies
• Strong international links
•Training

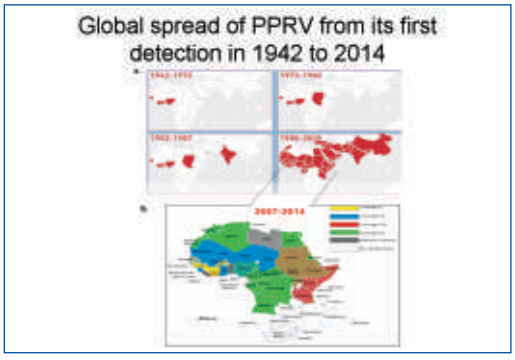
3


Strategy for PPR control and eradication
• Aim for PPR Eradication world-wide- 2030 (OIE/FAO)
• Understanding of disease epidemiology/ecology in the context of the socio-economic and farming systems
• Strategies and road maps need to be developed and monitored for surveillance and vaccination
• Vaccination with efficient live attenuated vaccines, DIVA vaccine at least at the the last phase of eradication
• Combine with other campaigns (including deworming and availability of multivalent vaccines) to improve small ruminant health and disease prevention and thus maximise available resources.

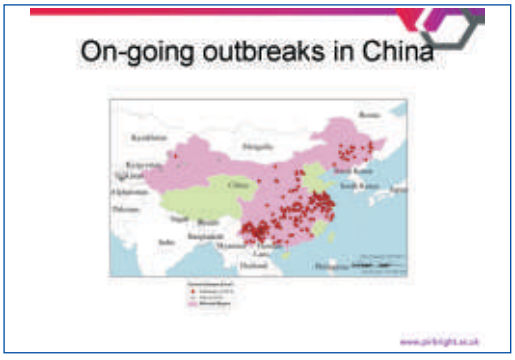
4


Impact of PPR in India
• In India PPR causes economic losses of 180 crores Indian rupees every year
• In AP the economic losses in the year 2005 was 126 crores rupees
• Derived by considering both direct and indirect losses:
– Due to mortality
– Due to loss of production
– Expenses towards diagnosis and treatment
– Due to distress sale

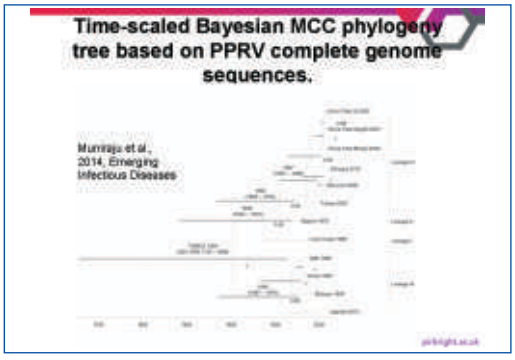
5


Global spread of PPRV from its first detection in 1942 to 2014

6

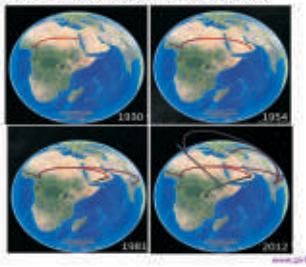

On-going outbreaks in China

7


Time-scaled Bayesian MCC phylogeny tree based on PPRV complete genome sequences.
Muniraju et al., 2014, Emerging Infectious Diseases

8

Geospatial spread of PPRV through time using Markov Chain (CTMC) and Bayesian Stochastic Search Variable Selection (BSSVS)



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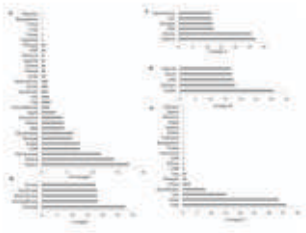
Probability of the root locations of the most recent common ancestral PPRV.



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Why was RPV eradication successful?

On the plus side....

- Provision of a safe, effective, live attenuated vaccine
- The presence of only one serotype of the virus
- Strong serosurveillance initiatives
- Often severe disease affecting large numbers of animals

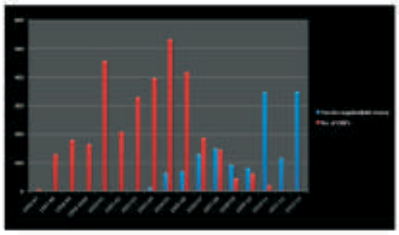
Challenges

- Poor economic infrastructural political will
- Poor laboratory conditions
- Ability for mild disease to circulate unnoticed among different species
- Possibility of wildlife reservoirs?
- Inability to differentiate between vaccinated and naturally infected animals ('DIVA' concept)

All of these points also apply to PPRV and its potential eradication

11

Vaccine Supply vs PPR outbreaks in AP, India



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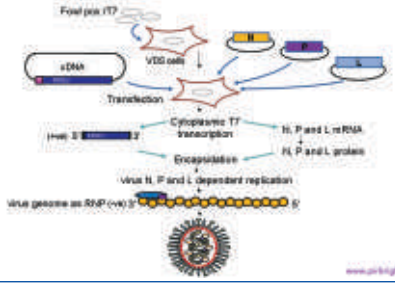
Rescue of PPRV using genetics technique



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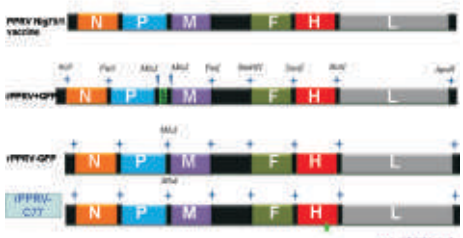
Design for PPRV Nigeria 75/1full length clone



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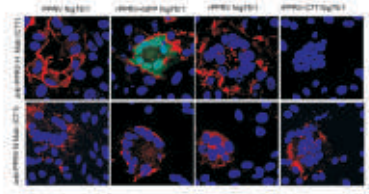
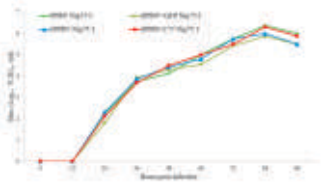
Confirmation through immunofluorescence staining



Muniraju et al., 2014 Vaccine

15

Multistep Growth



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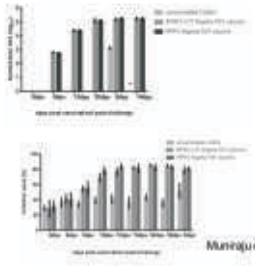
Body temperature of goats during vaccination and challenge period

17

VNT and C-HELISA results



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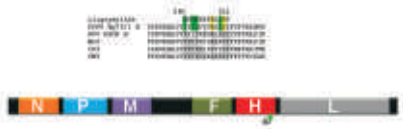
Identification of C77 mAb binding site using phage display technique



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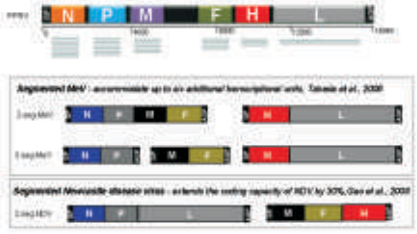
On-going work
Development of multivalent vaccine



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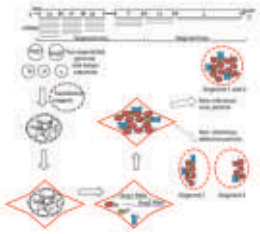
Two segmentation strategy



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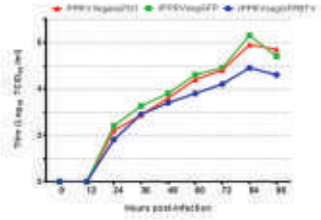
PPRBTVGFP multivalent vaccine- Multistep growth



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Conclusions

- Despite the existence of safe and efficacious vaccines for peste des petits ruminants virus (PPRV), the virus has emerged as a highly contagious disease across Asia, the Middle East and Africa
- Complete genome data for lineage-III isolates of PPRV are reported recently.
- A Bayesian phylogenetic analysis of all PPRV lineages mapped the time to most recent common ancestor and the initial divergence of PPRV to a lineage-III isolate at the beginning of twentieth century
- A phylogeographical approach estimated the probability for the root location of an ancestral PPRV and individual lineages as being Nigeria (for PPRV), Senegal (lineage-I), Nigeria/Ghana (lineage-II), Sudan (lineage-III) and India (lineage-IV).
- Reverse genetics technique has been established to facilitate PPR DIVA strategy-Needs further work
- Multivalent vaccine preparation using reverse genetics technique has been established

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What is required to eradicate the disease?

- Availability of vaccine for mass vaccination-minimum 85% coverage
- Pulse vaccination campaigns throughout the country
- Continuous vaccination regime to the border areas
- Monitoring & issuing vaccination certificates to migratory flocks
- Verification of vaccination certificates at inter-state borders
- Good disease reporting system from field staff which should actively supported by the state administration
- Sero-surveillance in small ruminants, if possible in future with DIVA concept
- Sero-surveillance of cattle and wildlife wherever required
- Vaccinations to young stock between 4-6 months of age
- Educating shepherds about the disease and control by vaccination-

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4.2 GALVmed in PPR Disease Control

Jeremy Salt
GALVmed, U. K.

PPR is an important disease identified by GALVmed for strengthening the capabilities in India. GALVmed is providing support to develop PPR recombinant vaccine with PPR for small ruminants. Development of thermostable PPR vaccine is also a part of the agenda. Development of the vaccine in smaller doses and establishing a good distribution network for cold chains are other issues being considered. The focus of GALVmed is to facilitate the availability of vaccine as a private good. Other areas of support required are assessment of constraints to control the disease in endemic regions, use of vaccine of different origins without restriction on strain or genotype, robust quality control system (AU PANVAC for Africa), monitoring on sero-surveillance and strengthening of vaccine distribution channels within endemic regions.

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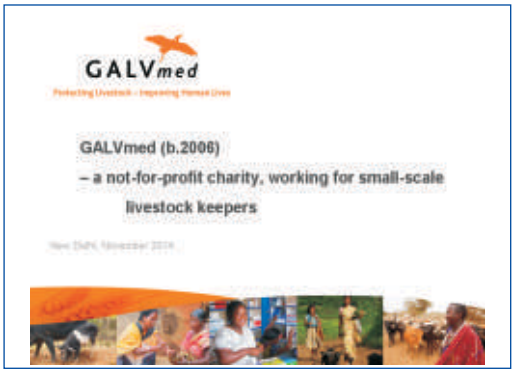

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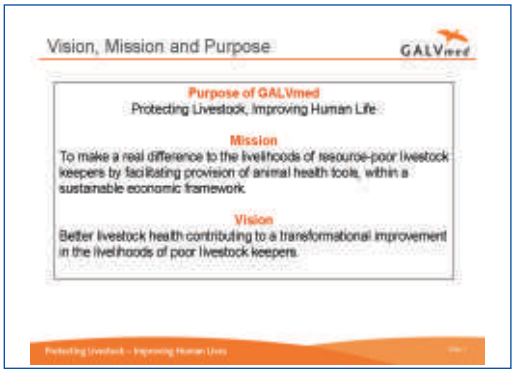

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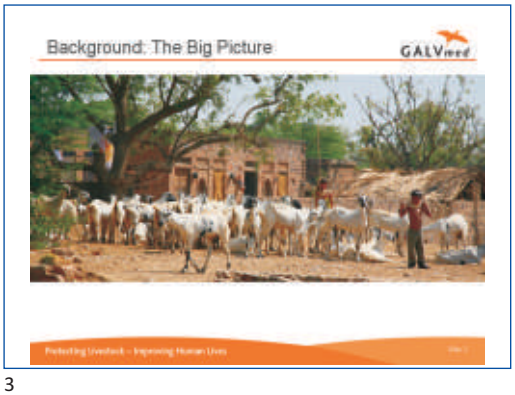

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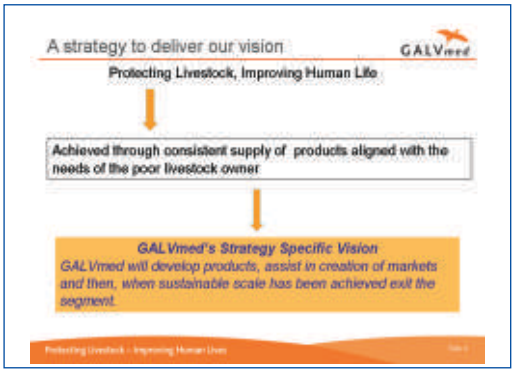

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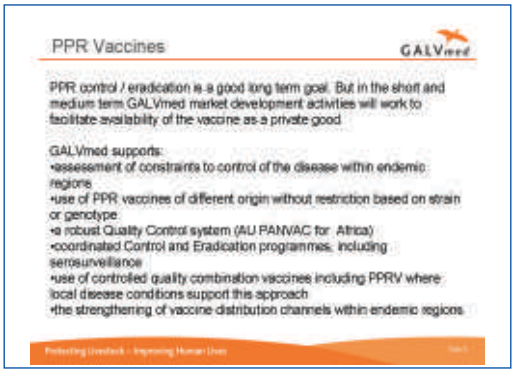

7

4.3 PPR Control - Initiatives of Hester Biosciences

Rajiv Gandhi

Managing Director, Hester Biosciences, Ahmedabad

Hester and GALVmed entered into a collaboration in 2009. Hester has already developed a thermostable New Castle vaccine for poultry. Hester PPR vaccine is now ready for use. The plan is to take up distribution of PPR vaccine along with deworming to ensure synchronization of both the activities. Hester is simultaneously creating awareness among farmers about the impact of the vaccine. They propose to select a few states like Jharkhand and Odisha and prepare a master plan for effective control of the disease. Creation of a distribution network and cold storage, training of paravets and vaccinators for support, are the proposed activities.

4.4 PPR Vaccine Aspects in a Control Programme

Danny Goovaerts
Consultant, GALVmed, U. K.

PPR is considered to be the most destructive disease of small ruminants and highly endemic in India. Major issues related to vaccination are which vaccine to use, which characteristics are needed for control, genotype, strain, Marker or DIVA vaccine, thermostable vaccine, dose presentation and quality (titre, shelf life, stability). Although there are four lineages, 1-3 are in Africa and lineage and 4 in Asia, North-Africa and Middle East. Presently, one single genotype is available. There is cross-immunity between Rinderpest and PPR. DIVA vaccines are most often recombinant vaccines demanding longer regulatory procedures and expensive diagnostics. However, this vaccine will be very useful at the latter stage in eradication by stamping out the disease. DIVA vaccine will also be useful to detect carrier status and remove persistently infected animals. Despite the availability of DIVA vaccine against various diseases, its use is relatively low. Improved thermostability will really make a difference in effective vaccination. Several existing PPR vaccines have already shown good thermostability. Good quality freeze dried vaccine will also help in keeping the quality high. Proper attention in vaccine production such as good quality raw material, maintaining sufficiently high titre in the vaccine and proper freeze dried technology can produce good quality stable vaccine. Fortunately, India has these facilities. Hence major focus should be on field programme. Use of improved diluents will also help in keeping the vaccine quality better. Mass vaccination should be taken up preferably during winter period to prevent damage to the vaccine. Intranasal vaccination has significant advantages over other vaccines. However, the technology is yet to be developed.

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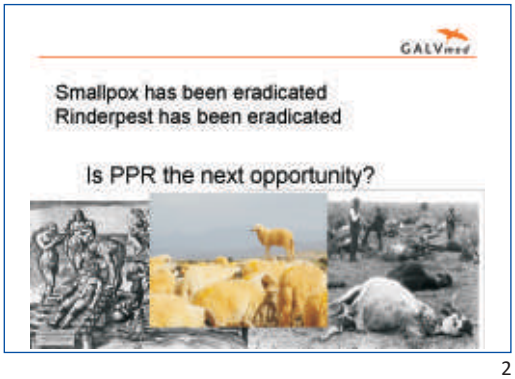

2

Contents

- Epidemiology and spread
- Vaccine aspects in a control program

Protecting Livestock – Improving Human Lives

3

Protecting Livestock – Improving Human Lives

4

Described as:

the most destructive viral disease of small ruminants

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5

Epidemiolgy:

PPR is highly endemic in India

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6

Which vaccine to use? Which characteristics do we need for control?

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7

Which vaccine to use? Which characteristics do we need for control?

- Which genotype? Which strain?
- Marker or DIVA vaccines?
- Thermostable vaccines?
- Dose presentations?
- Quality (titer, shelf life, stability)?

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Which Genotype, which strain?

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9

Type of Virus

- Paramyxoviridae, genus Morbillivirus
- Similar to:
  - Rinderpest virus
  - Measles virus
  - Canine distemper virus
- 4 lineages
  - Lineage 1-3: Africa
  - Lineage 4: Asia, North-Africa, Middle East
- One single serotype
  - Good cross-protection

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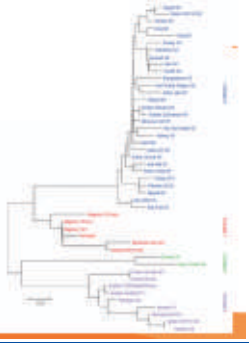
Phylogenetic Tree



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PPR Strain or genotype

GALVmed

- 4 genotypes but only one serotype
- Cross immunity between rinderpest and PPR, between canine distemper and measles
- OIE did remove referral to a specific strain or genotype (Nigeria 1/75) in 2013
- Use of Nigeria 75 strain vaccines in Northern Africa outbreaks (genotype 4) showed very good efficacy
- Pirbright is currently generating cross immunity data (against all 4 genotypes)

•All evidence sugests that the choice of the **vaccine genotype will play no role** in immuni and protection

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Marker vaccine, DIVA vaccine?

GALVmed

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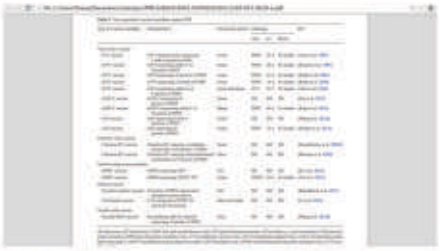
GALVmed



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Marker vaccine, DIVA vaccine, research interest or a real need?

GALVmed

- DIVA vaccinesmost often recombinant vaccines (more demanding and longer regulatory processes)
- DIVA vaccines need DIVA tests (diagnostics are generally more expensive than vaccines)
- DIVA vaccines can be useful in eradication by stamping out and slaughter
- DIVA vaccines can be useful to detect carriers status and remove persistently infected animals (e.g. herpes)
- For PPR carrier status never been reported
- Despite the existing of several DIVA vaccines/DIVA principles (PRV, IBR, Avian influenza, FMD, EHV, CSF) relatively limited use in a control program
- Rinderpest eradication without DIVA
- **A need for PPR control?**

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Thermostable vaccines?

GALVmed

- "Thermostable" or better vaccines of "improved thermostability" really made a difference at the end of the Rinderpest eradication
- "Thermostable" or "properly freeze-dried"?
- Freeze-dry technology (sugars, stabilisers,FD programs) greatly improved over time
- Several existing PPR vaccines show already great (thermo)stability

- Some Currently produced Good quality vaccines include Good Quality freeze-drying and improved thermostability

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What means "good quality vaccines" in the case of PPR?

GALVmed

- Proper control of raw materials and production parameters
- Sufficently high titer in the vaccine
- Proper freeze-dry technology (residual moisture %, stabilizers…)
- Good stability vaccines (e.g. no need to be kept frozen after freeze-drying)
- Produced and released at high quality standards

- Good PPR vaccines to control the disease already exist

The focus should probably be on proper control programs

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Topics for further consideration and R&D

GALVmed

- **Mass vaccination during the winter period**

•Intranasal vaccination (no needles, mucosal immunity, early protection in the face of MDA?)

- Improved diluents (virus protectants to preserve titers after reconstitution)

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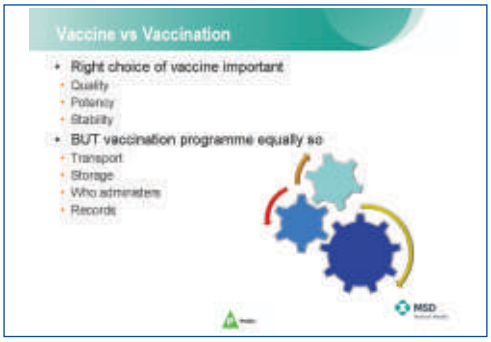
4.5 Strategies for PPR Control in India

Alasdair King
MSD Animal Health, the Netherlands

It is important to have good quality vaccine with potency. Equally important are transportation, storage and recording. A well planned programme for identification of villages, vaccination camps and training for vaccinators will be helpful. For successful eradication, it is necessary to have a national level plan, build capacities at all the levels, establish a well managed monitoring and documentation system, involve all the stakeholders and act after careful planning.

Please find the detailed information as given below:

1



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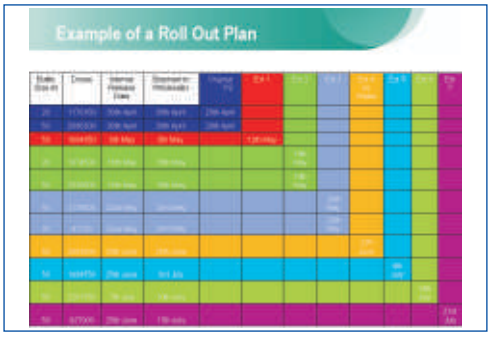

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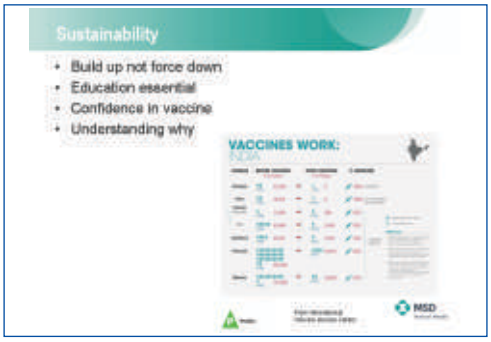

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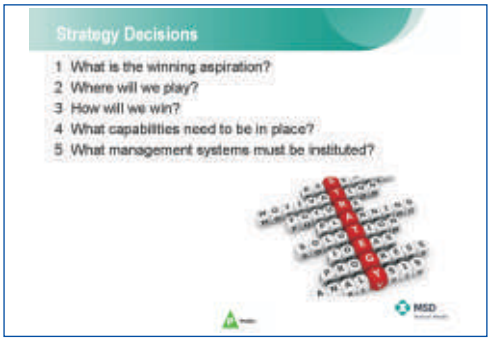

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4.6 Role of Indian Immunologicals in Control of PPR

K. Anand Kumar
Indian Immunologicals Ltd., Hyderabad

Policy support is needed for strengthening of the infrastructure and awareness of farmers and supply of vaccines at an affordable price. Training of vaccinators is also important. There is huge wastage of vaccine. Is this due to low cost or ignorance? There is a need to check the movement of animals, segregation of diseased animals and monitoring of the vaccination programme. We can start with recombinant vaccine and DIVA vaccine can be used at a later stage.

Co-Chair's Remarks

I take this opportunity to compliment all of you particularly the Indian Council of Agricultural Research and the Animal Husbandry Commissionerate, Government of India, who came forward with generous support for organising this conference and proposing the establishment of a Scientific Forum for eradication of PPR from India. We are extremely happy that GALVmed has also been given an opportunity to take part in this challenging task. With our international resource persons and experience, we will certainly take part whenever necessary to strengthen the programme. For launching such an initiative, we need to have a clear cut objective and action plan. With coordinated approach and good network of all the stakeholders, it should be possible to control the disease in the shortest possible time.

Chairman's Remarks

Considering the importance of PPR, Government of India has launched a National Programme for eradication of PPR in the 12th Five Year Plan, and Rs. 150 crores has been allocated for the first five years. We also realize the need for strengthening the infrastructure but control of animal movement is extremely difficult even within and outside the country. We have also recognized Pashumitras and non-veterinarians in vaccination and their role as vaccinators in a big way. Farmers in India are prepared to pay but due to lack of knowledge and hesitation, they ignore and neglect vaccination. I am happy that the conference is very timely, with active participation of renowned scientists representing important international research institutions and all the Indian vaccine manufacturers are here with their eagerness to support PPR disease control programme. The Government is very keen to have close interaction with all the stakeholders for eradication of this disease.

TECHNICAL SESSION 5:
Brainstorming on National Scientific Forum for PPR

Chairman: Dr. S. Bandyopadhyay

Member, Agricultural Scientists' Recruitment Board, ICAR, Government of India

The objective of this session was to identify the scope for establishing a National Scientific Forum, to identify the objectives and key players to be involved. All the delegates confirmed the need for this Scientific Forum and expressed that all stakeholders particularly scientists dealing with PPR disease should be encouraged to become active members of this forum. Membership should be open to the representatives of the Government of India, Research Institutions, Universities and Training Institutions, Vaccine Manufacturers and Distributors, State Animal Husbandry Departments, Civil Society Organisations, Farmers' Organisations and Donor Organisations. All the international organizations working on small ruminant development in India should also be invited to be members.

The Forum should be an independent institution with legitimate status, to work closely with other institutions and stakeholders to strengthen them, while generating funds from

various sources, to meet the programme costs. As the Animal Husbandry Commissioner, Government of India has direct influence on the State Governments, this office has to support the Forum for its effective functioning.

Ideally, the Government of India should identify a Coordinating agency for PPR eradication and the Forum should closely follow the national strategy and identify its role and work closely with other agencies. Forum should confine itself to an advisory role rather than involving itself in the programme implementation. Finally, the primary objective of helping the farmers should not be ignored.

Main Activities Proposed

- ✓ Identify the goal, mission and objectives of this forum.
- ✓ Create awareness among sheep and goat keepers.
- ✓ Undertake disease surveillance, and alert the Animal Husbandry Department and farmers about disease outbreaks.
- ✓ Promote studies on correct estimation of monetary losses due to PPR and impact on poor families.
- ✓ Promotion / Facilitation for mass vaccination on a mission mode.
- ✓ Prepare a standard operating procedure in consultation with Government agencies and make available to needy field professionals.
- ✓ Prepare success stories of different states and share with all states and policy makers. Strong messages should be sent through series of success stories.
- ✓ Arrange training for para-vets and field professionals
- ✓ Set up a dedicated Website for PPR. Maintain a standard procedure / manual for management and control of PPR disease on the website. Share relevant information on disease outbreaks and initiatives taken by various stakeholders. Maintain a databank.
- ✓ Serve as a Consultative body and a Support organisation for the Government and other stakeholders. Prepare a Panel of Resource Persons to address questions.
- ✓ Engage in Advocacy, Policy Development and Awareness and review the Minor Veterinary Services Act to include Vaccinators/Para-vets/Community Animal Husbandry Workers for vaccination.
- ✓ Identify research issues and interact with research institutions for facilitation and documentation.
- ✓ Forecast and address un-anticipated problems.

Supportive Role

The Forum can associate with Central and State Governments to develop the strategy and Action Plan for disease control. Members of the Forum can assist in strengthening of state level laboratories and to follow up for recognition of Indian Disease Investigation Laboratory for PPR by OIE with support from Pirbright Laboratory. While setting up the forum on PPR, we can also add other health-related issues, in due course.

CONCLUDING SESSION:

Peter Jeffries

CEO, GALVmed, Edinburgh, U. K.

It is very encouraging that all the participants came together towards a focussed common goal. Capacity building, diagnosis and timely vaccination play a key role. PPR has no dearth of good quality vaccines. However, it is better to be taken as a private good, if farmers are prepared to pay for vaccination. Establishment of a scientific Forum will be an excellent opportunity to establish a close network among various stakeholders to take a coordinated programme to eradicate PPR from India. GALVmed will be willing to take active part to strengthen the Forum. We have confidence in BAIF to take it forward.

Dr. Narayan Hegde

Trustee and Principal Adviser, BAIF

I am grateful to Dr. Peter Jeffries, CEO, GALVmed for his support for this Programme. I also thank Dr. Hameed Nuru, Senior Director, Policy & External Affairs, GALVmed, Gaborone Botswana, who has been guiding us in designing the conference and taking personal initiative to involve the international organisations in this conference. With his worldwide experience, particularly in Africa, we feel empowered to take this task ahead. We also count on further support from various international organisations particularly OIE, ILRI, FAO, IFAD, Bill and Melinda Gates Foundation, GALVmed and others. We are grateful to them and seek their support for launching the National Scientific Forum. We are thankful to all the delegates for their active involvement and will keep them informed about the development.

Mr. Ramesh Rawal, Trustee and Executive Vice President, BAIF proposed the vote of thanks.

PROGRAMME

Day 1: November 28, 2014

Registration of Delegates: 8.30 - 9.45 am

INAUGURAL SESSION

(10.00 - 11.30 am)

- **Welcome:** Dr. Narayan G. Hegde, BAIF
- **Opening Remarks** by Mr. Girish Sohani, President, BAIF
- **Address** by Dr. Peter Jeffries, CEO, GALVmed
- **Address** by Prof. Suresh S. Honnappagol, Animal Husbandry Commissioner, GoI
- **Presidential Address** by Dr. S. Ayyappan, Secretary, Department of Agricultural Research and Education (DARE) and Director General, ICAR
- **Vote of Thanks:** Dr. Mamta Dhawan, Regional Manager, South Asia, GALVmed
- **Keynote Address:** Dr. Philip Toye, ILRI

Tea break (11.30 am - 12 noon)

TECHNICAL SESSION 1:
PPR Status, Economic Impact and On-going Research

(12 noon to 1.30 pm)

Chairman: Dr. K.M.L. Pathak, DDG (Animal Sc.), ICAR

Speakers:

- **Dr. V. Balamurugan,** National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), Bangalore

  Epidemiology of Peste des Petits Ruminants in India

- **Mr. Ravi Israni,** Animal Husbandry, Government of Rajasthan

  Challenges of PPR Control in Rajasthan

- **Dr. G. Govindaraj,** National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), Bangalore

  Estimation of economic loss due to PPR in sheep and goats: An incremental prevalence based analysis

- **Dr. G. Hanmanth Reddy,** Veterinary Biological & Research Institute, Hyderabad
  Strategic control of PPR Disease in Andhra Pradesh
- **Dr. Avinash D. Deo,** BAIF
  Status of PPR in India

Lunch (1.30 - 2.30 pm)

TECHNICAL SESSION 2:
Status of Diagnostics and Vaccine Production: Problems and Opportunities
(2.30 - 4.30 pm)

Chairman: Dr. Mohinder Oberoi, Animal Health Consultant, FAO Expert, Ludhiana

Speakers:

- **S. Sireesha,** Veterinary Biological & Research Institute, Hyderabad
  A Study to analyse the infectivity titres of Peste Des Petits Ruminants (PPR) Vaccine produced in Roller Cultures
- **Dr. R.P. Singh,** IVRI, Izatnagar
  In-vitro selection and Molecular characterisation of a monoclonal antibody resistant mutant of an Indian strain of Peste des Petits Ruminants vaccine virus
- **Dr. S. Kilari,** Intervet India Pvt. Ltd., Wagholi and MSD Animal Health, Boxmeer, the Netherlands
  Safety and efficacy profile of OVILIS PPR vaccine in goats and sheep
- **Dr. D. Muthuchelvan,** Senior Scientist, In-charge - PPR Lab, Mukteshwar, Nainital District, Uttarakhand
  Molecular epidemiology of Peste-des-Petits Ruminants Viruses: 10 year study
- **Dr. Aman Kumar,** LLR University of Veterinary and Animal Sciences, Hisar
  Detection of Peste des Petites Ruminants virus by reverse transcription isothermal loop-mediated amplification
- **Dr. B. Mathivanan,** R&D Scientist, MSD Animal Health, Wagholi, Pune
  Thermostability profile of OVILIS PPR vaccine

Tea break (4.30 - 4.45 pm)

TECHNICAL SESSION 3:
Challenges of PPR Vaccination and Disease Control
(4.45 - 6.30 pm)

Chairman: Dr. Satya Parida, Head, Vaccine Differentiation Group, Institute for Animal Health, Pirbright, U. K.

Speakers:

- **Nagesh Pulicherla,** Indian Immunologicals Ltd., Hyderabad
  Control and Eradication of PPR - Role of Recombinant Vaccines
- **Dr. Ganesh G. Sonawane,** Central Sheep and Wool Research Institute, Avikanagar, Dist. Tonk, Rajasthan
  Seroprevalence of PPR in sheep and goats of selected districts of semiarid Rajasthan
- **Dr. Shankar Chinchkar,** Hester Biosciences Ltd., Ahmedabad
  PPR Control in India and Role of Hester
- **Karnati Srinivas,** Indian Immunologicals Ltd., Hyderabad
  ***Peste des Petits Ruminants* - Disease and its Control in India**
- **Dr. Goutam Roy,** Directorate of Veterinary Services, Chhattisgarh, New Raipur
  Mass Vaccination for prevention of PPR Disease on the lines of Pulse Polio Campaign - Experiences from Chhattisgarh
- **Dr. S.N. Singh,** Biovet Pvt. Ltd., Malur, Dist. Kolar, Karnataka
  Development of Vaccine for PPR: A Disease of Small Ruminants

Dinner (7.30 pm onwards) on the Lawns of NASC Complex

DAY 2: November 29, 2014

TECHNICAL SESSION 4:
Strategies for PPR Control in India
(9.30 - 11.30 am)

Chairman: Mr. Sanjay Bhoosreddy, Jt. Secretary, Administration and National Livestock Mission (ANLM), DADF, Government of India

Co-Chair: Dr. Hameed Nuru, GALVmed

Speakers:

- Keynote Address: Dr. Joseph Domenech, OIE
- Dr. Satya Parida, Pirbright Institute, UK
- Mr. Jeremy Salt, GALVmed
- Mr. Rajiv Gandhi, Hester Biosciences, Ahmedabad
- Dr. Danny Goovaerts, GALVmed
- Dr. Alasdair King, MSD Animal Health, the Netherlands
- Dr. K. Anand Kumar, Dy. Managing Director, Indian Immunologicals Ltd.

Tea break (11.30 am - 12 noon)

TECHNICAL SESSION 5:
Brainstorming on Establishing PPR Forum in India

(12 noon - 1.30 pm)

Chairman: Dr. S.K. Bandyopadhyay, Member, Agricultural Scientists Recruitment Board, ICAR, New Delhi

Brainstorming Session on suitable strategies and activities of the Forum

Lunch (1.30 - 2.30 pm)

SUMMING UP SESSION

(2.30-4.00 pm)

Speakers:

- Dr. Hameed Nuru
- Dr. Peter Jeffries
- Dr. Jeremy Salt
- Dr. Philip Toye
- Dr. Joseph Domenech

CONCLUDING SESSION

(4.00 - 5.00 pm)

Chairman: Dr. Peter Jeffries, CEO, GALVmed, UK

Co-Chair: Dr. Narayan Hegde, BAIF

Vote of Thanks: Mr. Ramesh Rawal, Trustee and Executive Vice President, BAIF

Annexure 1

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Annexure 2

PHOTOGRAPHS OF PROCEEDINGS


NATIONAL CONFERENCE
on
P.P.R. DISEASE
November 28-29, 2014
DR. K.M.L. PATHAK

Global Alliance for Livestock Veterinary Medicines (GALVmed)

GALVmed is a non-profit organisation that works with key partners to make a sustainable difference in access to animal health products for poor livestock keepers in Africa and South Asia. We protect livestock and improve human lives by making livestock vaccines, diagnostics and medicines accessible and affordable to the millions who rely on livestock as a lifeline.

We work with partners at all stages of the animal health-product value chain from: research, product development, product marketing, product delivery, influencing policy and advocacy. We make available and facilitate adoption of livestock health products by resource-poor livestock keepers through intervention in all necessary links of the value chain. This includes:

- ✓ Product development, registration, manufacture, commercialisation and delivery of livestock health products to the farmer
- ✓ Building capacity of all stakeholders from manufacturer to farmer
- ✓ Market development and adoption by creation of sustainable value chains to ensure that farmers receive the products.
- ✓ Understanding and influencing policy to enable the above
- ✓ Advocating for livestock as a route out of poverty and tool for food security

GALVmed has prioritised 12 diseases considered to be most relevant to poverty reduction in Africa and South Asia, of which Peste des Petits Ruminants (PPR) is in the frontline. Current funding supports many other diseases such as East Coast Fever, Newcastle disease, Porcinecysticercosis, etc.

Based on the needs of the small-holder poultry keepers in South Asia (India, Nepal and Bangladesh), a thermo-tolerant Newcastle disease vaccine was produced through GALVmed partners. We continue to raise awareness of the vaccine among backyard poultry farmers and community animal health workers. The vaccine is also being distributed in some African countries with the hope of locally manufacturing the vaccine in 2015.

With past funding we raised awareness of Newcastle disease and PPR and interventions available to tackle the disease through street theatre in Odisha, India. The performance educated viewers on the symptoms of Newcastle Disease and PPR, the low costs of vaccinating and deworming and the potential financial benefits to the community if these diseases are brought under control.

We are raising awareness of the East Coast Fever (ECF) vaccination to farmers in Africa. This serious disease is common among cattle in several African countries; however, one shot of the ECF Muguga Cocktail vaccine can protect the animal for life. We are currently raising awareness on the vaccine and working with manufacturers, distributors, vaccinators, farmers and regulatory authorities to ensure availability and adoption of the vaccine.

GALVmed's Trypanosomiasis project in Africa works with partners to research and develops new and improved drugs, diagnostics and perhaps in the not too distant future, even a vaccine.

If you would like to speak to a GALVmed representative regarding partnerships or information, email info@galvmed.org or mamta.dhawan@galvmed.org

For more information on our projects, visit www.galvmed.org

Organisers

ICAR

DADF, GoI

GALVmed

BAIF

Sponsors

MSD Animal Health

Indian Immunologicals Ltd.

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