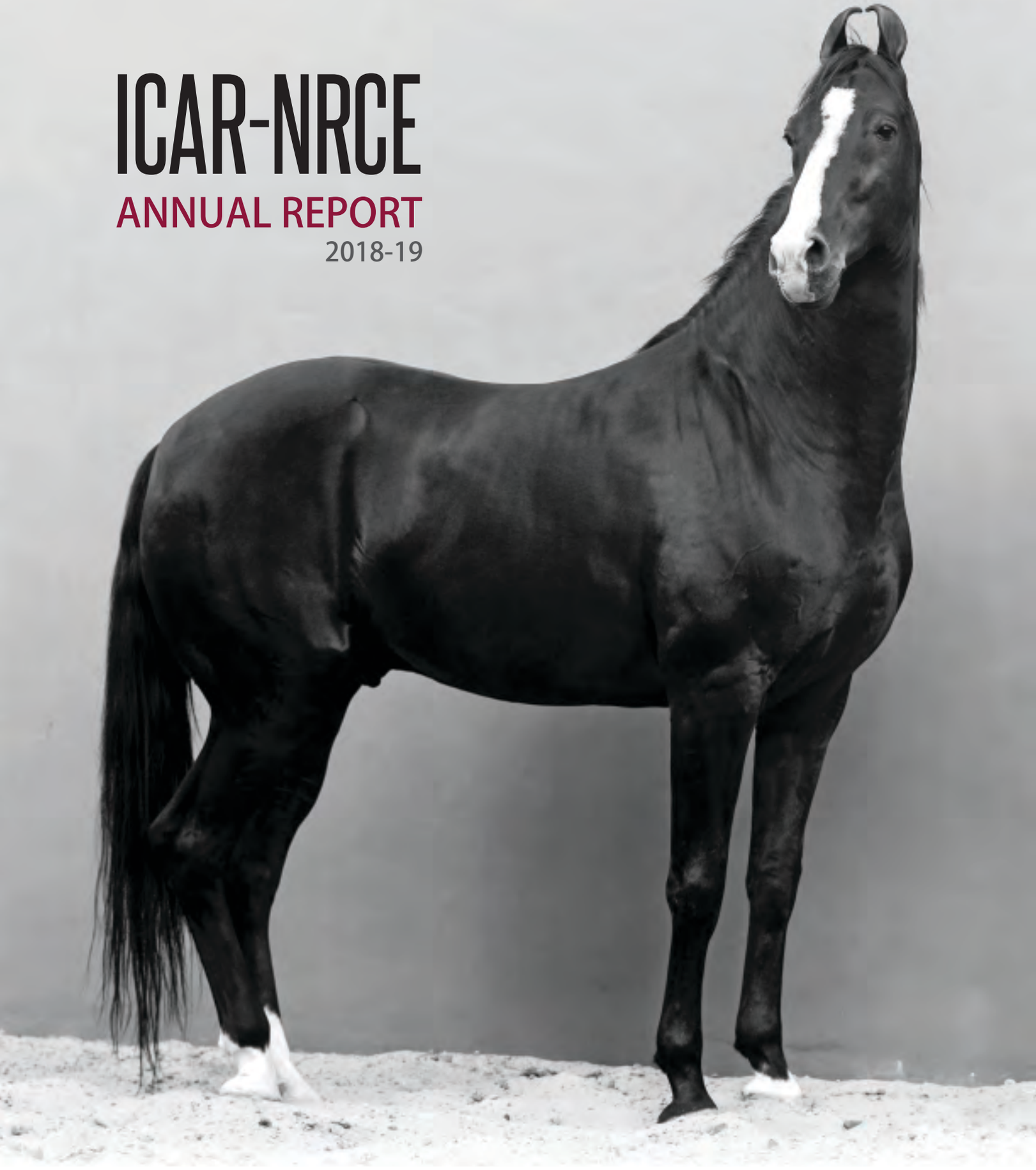
ICAR-NRCE

ANNUAL REPORT

2018-19



भा.कृ.अनु.प.–राष्ट्रीय अश्व अनुसंधान केन्द्र

ICAR-National Research Centre on Equines

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The achievements and activities of the Centre from April 2018 to March 2019 are presented in this report. Mention of trademark, proprietary product or firm in the report does not constitute an endorsement or rejection of other suitable products or firms.

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ICAR-National Research Centre on Equines

With best compliments from

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About the Cover

The Stallion Saptash is of Marwari horse breed. Marwari or Malani is a rare breed of horse from the Marwar region of India. These horses have majestic look with high- carried head, peculiar character of inward curved and touching ears. The breeding tract of this breed is mainly Jodhpur, Jalore, Sirohi, Jaisalmer, Barmer, Rajsamand and Udaipur of Rajasthan and in some pockets of Gujarat.

Photo Courtesy by :

Sh Manu Sharma

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Director's Foreword

The National Research Centre on Equines (NRCE) is a premier research institute of the ICAR in Animal Sciences, which is a component of National Agricultural Research System (NARS). It was established on 26th November 1985 at Hisar (Haryana) with a realization that equines play an important role in the economy of landless labourers and small and marginal farmers. The institute has made a balanced emphasis and remarkable achievements since its inception by pursuing basic, applied, and translational research, training and extension activities that have resulted in improvement of equine health and production in India. The institute has played a key role in eradication of some of the dreaded equine diseases and improving their health by developing novel diagnostics and vaccines. The NRCE is relentlessly working in providing diagnostic, advisory and consultancy services for augmenting equine productivity and quality in agriculture and transport. Frontier areas of research include development of new generation vaccines, nanotechnology-based rapid diagnostics, host-pathogen interaction, therapeutics including ethno-veterinary medicine, bacteriophages, genetic studies on livestock health and production, augmentation of reproductive efficiency, repository of microbes, etc.

The research and development activities of NRCE are achieved through well-structured research programmes comprising 24 institute and 12 externally funded research projects, which also include collaborative and inter-institutional research projects. NRCE has been successful in getting external fundings from almost all leading national funding agencies in the field of agricultural and biological sciences.

The research accomplishments of the scientists and students are reflected in 33 quality research papers besides several book chapters, invited paper/lectures, training manual/compendium, extension bulletins and two books (Handbook of equine practioners and *Peste des petits* ruminants: Sheep and Goat Plague). It is noteworthy to mention that the scientists of the institute have been publishing papers in highly reputed international journals such as CMR, FM, BMC Genomics, etc., and this has brought laurels and visibility of our research.

ICAR-NRCE is involved in nation-wide monitoring and sero-surveillance of important equine infectious diseases with a view to manage, control and eradicate them. This year the Centre has processed 37558 samples for glanders and 338 samples were diagnosed as positive from 11 Indian states. Beside this NRCE also tested 9517 samples for diagnosis of various equine diseases which generated revenue of Rs 60.69 lakhs.

The Centre has developed recombinant antigen based ELISA's for diagnosis of glanders, equine infectious anaemia, Japanese encephalitis and latent EHV1 infection. Two of these kits (Glanders and EIA ELISA) were relased by Sh. Radha Mohan Singh Ji Hon'ble Minister of Agriculture & Farmer's Welfare. These assays/kits are highly economical as compared to imported kits and have been validated in internal and external laboratories. Besides these ELISA's, we have also developed a rapid diagnostic test - lateral flow assay (LFA) for Glanders. This ELISA diagnostic kit and LFA have a huge potential of international commercialization and will prove to be a milestone in controlling these diseases in India.

We have also established new milestone in the area of equine production and reproduction. During cryopreservation of equine semen, oxidative stress used to be a major problem, which is responsible for decreasing post-thaw motility of spermatozoa and their fertility potential. NRCE scientists have successfully overcome this problem and were able to decrease the oxidative stress by supplementing cholesterol loaded cyclodextrins during cryopreservation process. Efforts were also made to identify genes affecting the fertility and endurance capability of stallions. This would help in selection of good quality stallion which is very crucial for breed improvement.

In India, a decrease of 27% was observed in donkey populations over the last 5 years which is mainly due to mechanization of agriculture and transport. Conservation and propagation of Indian donkeys is a pertinent issue. The donkey milk based cosmetics and health mixtures can be an attractive agribusiness for equine farmers in India and may likely to help in conservation and propagation of Indian donkeys. We have initiated a new vista of developing cosmetics using donkey milk. Donkey milk has been known since ages for its therapeutics and aesthetic properties. Efforts have been made to develop formulations and methodology for making soap and body butter from donkey milk. This will open a new window of agri-entrepreneurship for our donkey keepers.

The team of scientists at NCVTC during this year, accessioned a total of 267 microbes of veterinary importance in the repository thereby achieving a cumulative strength of 3746. In the virus repository, 35 viruses were accessioned. A total of 25 bacteriophages were also isolated. Complete genome analysis of two chicken astroviruses and genetic characterization of four strains each of porcine circovirus 2 & 3 (PCV2 & PCV3) were also carried out during this period. CRISPR (clustered regularly interspaced short palindromic repeats)/Cas9 technology was exploited to develop knock out HeLa cells deficient in antiviral (anti-HSV1) cellular protein CBX-5. The CBX-5 knockout cells were successfully developed and validated.

Effort on generation of laboratory induced development of phage resistant mutant yielded successful results. A new phage against a laboratory induced resistant mutant was obtained. A study was also initiated on antimicrobial resistance in which *Staphylococcus aureus* and *Escherichia coli* isolates from cattle, sheep, goat, pigs and poultry will be tested for carriage of various AMR factors.

The ICAR-NRCE has inked the MoU with the CCS Haryana Agricultural University, Hisar and GLA, Mathura for the cooperation in the areas of research & education, training & capacity building, extension consultancy and other areas of national interest.

The Centre extended equine welfare activities in different parts of the country by organizing equine health camps, *kisan goshtis* and farmer interactive meets to update the know-how and educate equine owners on various aspects of disease control and management. Under *Mera Gaon Mera Gaurav* programme NRCE scientists coordinated agriculture, animal health related activities and social awareness through government officials and village Panchayats. The emphasis has been laid on creating awareness about diagnosis and treatment of affected animals, soil conservation, controlled use of chemical fertilizers by the farmers etc.

The Centre has taken a novel initiative for conservation and propagation of equines through making the equines popular by launching equine tourism programme at its Bikaner campus, where an equine museum, herbal park, information centre, souvenir shops have been established. In addition, *Buggy*, *tonga* and horse riding has been started, which gained not only popularity amongst visiting tourists but also generating countable income.

I would like to take this opportunity to record my sincere thanks to the Chairman and the members of the Publication Committee for bringing out this excellent annual report of the Centre with a new look and substantial improvement in the quality of its publication.

I am extremely thankful to the Council for overwhelming support in terms of resources, guidance and various other facilities. I sincerely thank Dr Trilochan Mohapatra, Secretary, DARE and Director General, ICAR for his kind guidance, moral support and whole-hearted encouragement extended to me and the institute. I gratefully acknowledge constant support and guidance by Dr Joykrushna Jena, Deputy Director General (Animal Science), ICAR, New Delhi. My thanks are also due to the Assistant Director Generals Dr Ashok Kumar (Animal Health) and Dr R.S. Gandhi (Animal Production and Breeding) and Principal Scientists (Dr Rajan Gupta, Dr Vineet Bhasin, Dr Jyoti Misri) at ICAR Headquarters for their continuous support to NRCE.

Btripathi

(B.N. Tripathi)

Executive Summary

कार्यकारी सारांश

NRCE

During the year 2018-19, 1170 equine serum samples from 10 states were tested for various diseases like equine infectious anaemia (EIA), equine influenza (EI), EHV-1, JEV, trypanosomosis, equine piroplasmosis, *Salmonealla Abortusequi* and brucellosis. Total number of clinical samples positive for various diseases were 799 (60.85%) for *Theileria equi*, 225 (15.56%) for EHV-1, 101 (6.98%) for *Trypanosoma evansi,* 34 (2.35%) for JEV and 9 (0.62%) for equine influenza. None of the equines were found positive for equine infectious anemia, brucellosis and *Salmonella abortusequi*. Under disease investigation, 24001 equine sera were tested for glanders at NRCE and 13557 samples were tested by six state diagnostic laboratories using ELISA supplied by NRCE. Out of these 37558 samples tested, 338 were found positive for glanders from 11 states of the country. Under contractual diagnostic services, a total of 9517 samples received from race courses, turf clubs, stud farms, riding schools and other organized sector were tested *viz* EIA, glanders, EHV-1, *T. evansi*, EIV, dourine, WNV, piroplasmosis, AHS, EVA, CEM and generated a revenue of 60.69 lakhs.

In order to diagnose latent EHV-1 infection, nested (gB-nPCR) and real-time PCR (gB-qPCR) targeting glycoprotein B (gB) were standardized. Both the assays were found to be specific for EHV-1. The nested PCR (gB-nPCR) and real-time assays were found to be highly specific and have diagnostic sensitivities of 1340 fg (4.1×10^3 gene copies) and 13.4 fg (41 copies) respectively. Whole genome sequencing comparison of Indian EHV-1 isolates with other published isolates revealed that Indian isolates were more closely related to EHV-1 isolates (OH03 and VA02) from Japan (97.4-98.8%). Phylogenetic analysis based on Vs region classified our isolates into clade 5 along the reference isolate V592.

रा.अ.अनु.के.

वर्ष 2018–19 के दौरान, 10 राज्यों के 1170 इक्वाइन सीरम के नमूनों को विभिन्न रोगों जैसे कि अश्व संक्रामक एनीमिया (ईआईए), इक्वाइन इन्फ्लुएंजा (ईआई), ईएचवी–1, जेइवी, ट्रिपैनोसोमोसिस, इक्वाइन पायरोप्लास्मोसिस, साल्मोनेला एबोर्ट्स इक्वाई और ब्रूसेलोसिस के लिए परीक्षण किया गया। विभिन्न रोगों के लिए पॉजिटिव नैदानिक नमूने की कुल संख्या थीलेरिया इक्वाई के लिए 799 (60.85%), EHV-1 के 225 (15.56%), ट्रिपेनोसोमा इवान्साई के लिए 101 (6.98%), जेईवी के लिए 34 (2.35%) और इन्फ्लूएंजा के लिए 9 (0.60%) है। संक्रामक एनीमिया, ब्रुसेलोसिस और साल्मोनेला एबोर्ट्सइक्वाई के लिए कोई भी नमूना पॉजिटिव नहीं पाया गया। रोग की जाँच के तहत एनआरसीई में ग्लैंडर्स के लिए 24001 इक्काइन सीरा का परीक्षण किया गया और 13557 नमूनों का परीक्षण छः राज्य की नैदानिक प्रयोगशालाओं ने एनआरसीई द्वारा दी गई एलिसा किट का उपयोग करते हुए किया गया। परीक्षण किए गए 37558 नमूनों में से, देश के 11 राज्यों के 338 नमूने ग्लैंडर्स के लिए पॉजिटिव पाए गए। संविदात्मक नैदानिक सेवाओं के तहत, रेस कोर्स, टर्फ क्लब, स्टड फार्म, राइडिंग स्कूल और अन्य संगठित क्षेत्र से प्राप्त कुल 9517 नमूनों का परीक्षण किया गया। ईआईए, ग्लैंडर्स, ईएचवी–1, टी इवान्साई, ईआईवी, डोरीन, जेइवी, पायरोप्लाज्मोसिस, एएचएस, ई.वी.ए. के माध्यम से 60.69 लाख का राजस्व अर्जित किया गया।

अव्यक्त EHV-1 संक्रमण के निदान करने के लिए, ग्लाइकोप्रोटीन B(gB) को लक्षित करने वाले नेस्टेड (gB-nPCR) और रीयल–टाइम PCR (gB-qPCR) को मानकीकृत किया गया। दोनों assays EHV-1 के लिए विशिष्ट पाए गए। नेस्टेड पीसीआर (gB-nPCR) और रीयल–टाइम एस्से को अत्यधिक विशिष्ट पाया गया और क्रमशः 1340 fg (4.1 X103 जीन प्रतियां) और 13.4 fg (41 प्रतियां) की नैदानिक संवेदनशीलता है। भारतीय EHV-1 आइसोलेट्स के पूरे जीनोम अनुक्रमण की तुलना में अन्य प्रकाशित आइसोलेट्स के साथ मिलान से पता चला है कि भारतीय EHV-1 आइसोलेट्स (OH03 और VA02) की जापान आइसोलेट्स (97.4–98.8%) से अधिक निकटता से संबंधित

Efforts were made for the development of recombinant EHV-1 viruses employing bacterial artificial chromosome mediated mutagenesis to explore its utility as a vaccine candidate. In this regard, transfer cassettes for deletion of genes *viz.,* IR6, pUL43 and pUL56 were generated. The various deletion mutant EHV1-BAC constructs were generated. The growth kinetic evaluation revealed that growth pattern of the mutant virus (intra cellular and extracellular) was reduced as compared with wild strain. Efforts were also made for insertion of point mutation in ORF30 gene of EHV-1 by designing a transfer cassette. The point mutation was inserted into the EHV-1BAC constructs following *en passant* mutagenesis strategies.

Development of monoclonal antibody based sandwich ELISA kit for detection of EIV antigen was also initiated. The assay was able to detect the viruses from all the lineages barring H7N7 and a small reduction in OD for the antigen from Miami/63 virus. Further, comparative pathology of a reverse genetics engineered 6:2 re-assortant equine influenza (H3N8) virus was evaluated in mouse model. The recombinant equine influenza virus had a backbone of H1N1 (WSN/33 system) and HA and NA segments from H3N8 belonging to clade 2 of Florida sub lineage isolated from an outbreak of 2008-09 in India. The study revealed that there were no remarkable differences in lesions in recombinant RG virus group vs wild EI virus.

Seasonal distribution of Japanese encephalitis virus sero-positivity among pigs in Assam was evaluated. A total of 1357 pigs from eight districts of Assam in different seasons were tested for JEV antibodies and 228 (16.80%) were detected positive, indicating high JEV seropositivity in pig population of the region. The sequence analysis of envelope genes of these viruses revealed a 100% identity with human and equine JEV isolates from West Bengal, Vellore, Haryana and Lucknow. The most prevalent vectors identified were *Culex tritaeniorhynchus*, *Cx. gelidus* and *Mansonia sps*.

An Indirect ELISA was also developed using JEV-E protein immunodominant epitope of 444 bp expressed in *E. coli* for the detection of JEV specific antibodies in horses and pigs. The assay has been transferred to NE region labs and is being used for validation on pig serum samples. The ELISA has now been transformed to a diagnostic kit for detection of JEV antibodies in equines. More than 350 samples of horses, donkeys, mules and pigs have been tested for JEV by ELISA and results have been compared with HI and VNT.

थे। वंशवली विश्लेषण ने हमारे आइसोलेट्स को क्लैड 5 में रेफरेंस V592 के साथ वर्गीकृत किया।

बैक्टीरियल कृत्रिम क्रोमोसोम मध्यस्थता उत्परिवर्तजन को नियोजित करने वाले पुन: संयोजक ईएचवी-1 वायरस के वैक्सीन के उम्मीदवार के रूप में इसकी उपयोगिता का पता लगाने के विकास के लिए प्रयास किए गए। इस संबंध में, जीन IR6, pUL43 और pUL56 को हटाने के लिए ट्रांसफर कैसेट उत्पन्न किए गए थे। विभिन्न विलोपन उत्परिवर्ती EHV1-BAC निर्माण उत्पन्न किए गए। विकास गतिज मूल्यांकन से पता चला है कि वाइल्ड स्ट्रेन की तुलना में उत्परिवर्ती वायरस (इंट्रा सेलुलर और बाह्यकोशिकीय) का विकास पैटर्न कम हो गया था।

एक मोनोक्लोनल एंटीबॉडी आधारित सैंडविच एलिसा किट का विकास, EIV एंटीजन का पता लगाने के लिए भी शुरू किया गया। एस्से H7N7 और मियामी/63 वायरस से एंटीजन के लिए ओडी में एक छोटी-सी कमी छोड़कर सभी वंशावली से वायरस का पता लगाने में सक्षम थे। इसके अलावा, एक रिवर्स जेनेटिक्स के तुलनात्मक विकृति ने 6: 2 को फिर से इक्काइन इन्फ्लूएंजा (H3N8) वायरस के लिए माउस मॉडल में मूल्यांकन किया गया। पुन: संयोजक इक्वाइन इन्फ्लूएंजा वायरस, H1N1 WSN/33 प्रणाली) और H3N8 से HA और NA खण्ड़ों का एक आधार था, जोकि फ्लोरिडा के उप वंश 2 से जुड़ी थी, जो भारत में 2008-09 के प्रकोप से अलग थी। अध्ययन से पता चला है कि पुन: संयोजक आरजी वायरस समूह बनाम वाइल्ड ईआई वायरस के घावों में कोई उल्लेखनीय अंतर नहीं था।

असम में सुअरों के बीच जापानी एन्सेफलाइटिस वायरस के मौसमी वितरण का सीरोपॉजिटिविटी का मूल्यांकन किया गया था। विभिन्न मौसमों में असम के आठ जिलो के कुल 1357 सूअरों का परीक्षण जेईवी एंटीबॉडी के लिए किया गया और 228(16.80%) का पता लगाया गया, जो क्षेत्र की सुअर आबादी में उच्च जेईवी सीरोपॉजिटिविटी का संकेत देता है। इन विषाणुओं के एनवलप जीन के अनुक्रम विश्लेषण से मानव के साथ 100% पहचान का पता चला और यह पश्चिम बंगाल, वेल्लोर, हरियाणा और लखनऊ के जेईवी से अलग है। पहचाने जाने वाले सबसे प्रचलित वैक्टर क्यूलेक्स ट्राइटेनियोरिन्चस, Cx जेलिडस और मैनसनिया एसपीएस थे।

घोड़ों और सुअरों में जेईवी की विशिष्ट एंटीबॉडी का पता लगाने के लिए ई-कोलाई में व्यक्त 444 बीपी के जेईवी-ई प्रोटीन इम्युनोडोमिनंट एपिटोप का उपयोग करके एक अप्रत्यक्ष एलिसा भी विकसित किया गया था। एस्से को नार्थ-ईस्ट क्षेत्र की प्रयोगशालाओं में स्थानांतरित कर दिया गया है और सुअर सीरम के नमूनों पर सत्यापन के लिए उपयोग किया जा रहा है। अब एलिसा को जीवाणुओं में जेईवी एंटीबॉडी का पता लगाने के लिए एक डायग्नोस्टिक किट में बदल दिया गया है। एलिसा द्वारा जेइवी के लिए घोड़े, गधे, खच्चर और सूअरों के 350 से अधिक

Efforts were made for the development and validation of ELISA and a point of care rapid diagnostic tests for glanders. In this regard, various recombinant proteins *viz.,* Hcp1, TssA and TssB were bulk produced and indirect ELISA kits and lateral flow assay (LFA) were developed. These kits were tested in-house with the sera panel and found to have 98% sensitivity and 99% specificity. The life expectancy of the ELISA kits was found to be 18- 24 months at 4°C. In the next phase, these kits will be validated by third party in 8 diagnostic laboratories in India and in OIE Reference Laboratory on Glanders, Germany and European Union Reference Laboratory, France.

Towards the development of multiple antigen immunoassay for improved diagnosis of glanders, 24 secretory proteins belonging to T2SS, T3SS, T5SS and T6SS secretory systems of *B. mallei* were identified. These secretory proteins were used for epitope mapping and designing of six chimeric fusion proteins.

To find the prevalence and associated risk factors of *Rhodococcus equi* in the foals in the desert, semi desert and canal irrigated areas of north western and west Rajasthan, a study on 100 foals selected from various districts of Rajasthan revealed that 18% of foals (age <12 months) were positive for the fecal shedding of pathogenic *R. equi*. It was also observed that the incidence was high in foals born in month of July. Efforts were also made to find an herbal disinfectant for farm soil to prevent aerosol infection of *R. equi* in foals. *Tamarindus indica* and *Eucalyptus globulosa* leaves aqueous extracts were tested *in-vitro* against *R. equi*. Aqueous extracts of both the plants were found having anti *R. equi* efficacy.

A multiplex PCR was standardized to diagnose and differentiate *Streptococcus equi subsp equi* and *zooepidemicus* using the isolates available in the repository. In addition, seven housekeeping genes of 28 *Streptococcus equi* isolates were sequenced and analysed to assign Multi Locus Sequence Types (MLST). This analysis revealed diversity amongst Indian isolates of *S. equi.*

For rapid diagnosis of trypanosomosis, a user friendly LFA was developed using recombinant proteins *viz.,* flagellar, ISG and tandem repeat antigen. The LFA strips were prepared using these recombinant antigens individually, cocktail of these three antigens and also WCL antigen for validation of assay. The results revealed sensitivity of LFA ranged from 48.48 % - 89.53 % at 95 % CI with different antigens. The

नमूनों का परीक्षण किया गया है और परिणामों की तुलना एचआई और वीएनटी से की गई है।

एलिसा के विकास, सत्यापन और ग्लेंडर्स के लिए पॉइंट ऑफ केयर रैपिड डायग्नोस्टिक परीक्षणों के लिए प्रयास किए गए। इस संबंध में विभिन्न पुन: संयोजक प्रोटीन अर्थात् एचसीपी-1, टीएसएसए और टीएसएसबी का उत्पादन किया गया और अप्रत्यक्ष एलिसा किट और पार्श्व प्रवाह एस्से (एलएफए) विकसित किया गया। इन किटों को सीरा पैनल के साथ इन-इाउस परीक्षण किया गया और पाया गया कि इसमें 98% संवेदनशलता और 99% विशिष्टता है। एलिसा किट की जीवन प्रत्याशा 4°C पर 18-24 महीने पाई गई। अगले चरण में इन किटों को तीसरे पक्ष द्वारा मान्य करने के लिए भारत में 8 नैदानिक प्रयोगशालाओं और ग्लैंडर्स OIE संदर्भ प्रयोगशाला, जर्मनी में और यूरोपीय संघ संदर्भ प्रयोगशाला, फ्रांस में किया जाएगा।

ग्लैंडर्स के बेहतर निदान के लिए मल्टीपल एंटीजन इम्युनोएस्से के विकास के लिए बी मलाई के T2SS, T3SS, T5SS और T6SS स्रावी प्रणालियों से संबंधित 24 स्रावी प्रोटीन की पहचान की गई। इन स्रावी प्रोटीनों का उपयोग एपिटोप मैपिंग और छ: काइमेरिक फ्यूजन प्रोटीनों की डिजाइनिंग के लिए किया गया था।

उत्तर पश्चिमी और पश्चिमी राजस्थान के रेगिस्तानी, अर्ध रेगिस्तानी और नहर सिंचित क्षेत्रों में फोल्स में रोडोकोकस इक्वाई के प्रचलन और जुड़े जोखिम कारकों को खोजने के लिए राजस्थान के विभिन्न जिलों में चुने गए 100 फॉल्स पर किए गए एक अध्ययन से पता चला है कि 18% फॉल्स (उम्र <12 महीने) रोगजनक आर इक्वाई बैक्टीरिया के फीकल शेडिंग के लिए पॉजिटिव थे। यइ भी देखा गया है कि जुलाई के महीने में पैदा हुए फोल्स में यह संयोग अधिक था। फॉल्स में आर इक्वाई के एरोसोल संक्रमण को रोकने के लिए बाड़ों की मिट्टी के लिए एक हर्बल कीटाणुनाशक खोजने के लिए भी प्रयास किए गए। इमली और यूकेलिप्टस ग्लोब्युलोसा के पत्तों के जलीय अर्क का इन-विट्रो में आर इक्वाई के खिलाफ परीक्षण किया गया। दोनों पौधों के जलीय अर्क में एंटी आर इक्वाई प्रभावोत्पादकता पाई गई।

मल्टीप्लेक्स पीसीआर को स्ट्रेप्टोकोकस इक्वाई सबस्प इक्वाई और जूओपिडेमिक्स को रिपॉजिटरी में उपलब्ध आइसोलेट्स का उपयोग करके निदान और अंतर करने के लिए मानकीकृत किया गया। इसके अलावा, 28 स्ट्रेप्टोकोक्स इक्वाई आइसोलेट्स के सात व हाउसकीपिंग जीनों को मल्टी लॉक सीक्वेंस टाइप (एमएलएसटी) असाइन करने के लिए अनुक्रमित और विश्लेषण किया गया। इस विश्लेषण ने एस इक्वाई के भारतीय आइसोलेट्स के बीच विविधता का पता लगाया।

ट्रिपैनोसोमोसिस के शीघ्र निदान के लिए उपयोगकर्ता के अनुकूल एलएफए को पुन: संयोजक प्रोटीन नामत: फ्लेजेल्लर, ISG और अग्रानुक्रम रिपीट एंटीजन का उपयोग करके विकसित किया

diagnostic sensitivity and specificity of WCL-LFA, ISG-LFA and cocktail antigen-LFA yielded comparatively better results for diagnosis of *T. evansi* infection. The TR-LFA was found to be least sensitive.

LFA devices were prepared for diagnosis of *T. equi* antibodies in serum. Samples were tested in ELISA and LFA and results were compared. A total of 204 samples were also tested simultaneously in ELISA, IFAT, LFA and MASP culture system and 148, 137, 140 and 124 samples were found positive, respectively, in these assays.

Research work was also initiated for developing novel drugs against *T. equi* infection from herbal plants. The *Acacia nilotica* methanolic extract was found effective in *in-vitro T. equi* MASP culture system. *Acacia nilotica* extract was further fractionated to yield ANMH, ANMC, ANMEA, ANMEAE, ANME, ANMMA elutes.The ANMEA eluted fraction showed better growth inhibition potential among the six fractions with lowest IC_{50} of 34.56 μg/ml. GC/MS analysis revealed presence of benzene, Octadecane, Eicosane, n-nonadecanol, etc.

Evaluation of nano-formulations for healing properties on equine fibroblast cells revealed encouraging results in *in-vitro* studies. Partial anterior cruciate ligament transection (ACLT) was successfully performed to develop rabbit model of arthritis. Histopathological evaluation and cytokines gene expression revealed inflammation in murine models of arthritis.

LFA was developed for pregnancy diagnosis in horse mares. Purified anti-eCG mAb was used as capture antibody and anti-rabbit IgG as conjugated antibody.

A total of 1810 semen straws of Marwari and 570 semen straws of each Zanskari and Manipuri stallions were cryopreserved. AI services were provided to 29 mares, whereas 35 mares were examined for pregnancy through ultrasonography. Further, 36 semen doses (362 straws) were distributed free of cost to the field veterinarians and to the academicians for popularizing AI among equines.

Effect of cholesterol-loaded cyclodextrins (CLC) was evaluated on stallion and jack sperm motility. Addition of CLC (1 to 2mg/120 $\times$ 10^6spermtaozoa) significantly improved 'Cholesterol: Phospholipid' ratio of cryopreserved spermatozoa by reducing the total antioxidant capacity and oxidative stress thus resulting in better semen freezability as revealed by higher progressive motility, HOS response, livability, acrosomal integrity and DNA integrity of spermatozoa.

गया। एलएफए स्ट्रिप्स को पुनः संयोजक एंटीजन का अलग-अलग प्रयोग कर डब्ल्यूसीएल एंटीजन का इन तीन एंटीजन के कॉकटेल और एस्से के सत्यापन के लिए उपयोग किया गया था। एलएफए की संवेदनशीलता का परिणाम 48.48% – 89.53% 95% CI से अलग-अलग एंटीजन से पाया गया। डब्ल्यूसीएल-एलएफए, आईएसजी-एलएफए और कॉकटेल एंटीजन एलएफए की नैदानिक संवेदनशलता और विशिष्टता टी-इवान्साई संक्रमण के निदान के लिए तुलनात्मक रूप से बेहतर परिणाम देती है। TR-LFA कम से कम संवेदनशील पाया गया।

एलएफए उपकरणों को सीरम में टी इक्की एंटीबॉडी के निदान के लिए तैयार किया गया। सैंपल के एलिसा और एलएफए में परीक्षण किए गए और परिणामों की तुलना की गई। एलिसा, आईएफएटी, एलएफए और एमएएसपी कल्चर प्रणाली में कुल 204 नमूनों का एक साथ परीक्षण किया गया और इन एसेज में क्रमशः 148, 137, 140 और 124 नमूने पॉजिटिव पाए गए थे।

हर्बल पौधों से टी इक्वाई संक्रमण के खिलाफ नव दवा विकसित करने के लिए अनुसंधान कार्य भी शुरू किया गया। बबूल निलोटिका मेथेनॉलिक अर्क इन-विट्रो टी इक्वाई एमएएसपी कल्चर प्रणाली में प्रभावी प्राया गया था। बबूल नीलोटिका अर्क को फिर ANMH, ANMC, ANMEA, ANMEAE, ANME, ANMMA एलीट उपज के लिए अलग किया गया था। ANMEA eluted अंश ने 34.56 ofg/ml के निम्नतम 50 आईसी के छः अंशों में बेहतर वृद्धि अवरोध क्षमता को दिखाया। जीसी/एमएस विश्लेषण से बेंजीन, ऑक्टाडकेन, इकोसैन, एन-नॉनडैकोनोल, आदि की उपस्थिति का पता चला। नैनो-योगों का मूल्यांकन इन-विट्रो अध्ययनों में समान फाइब्रोब्लास्ट कोशिकाओं पर उपचार गुणों के लिए उत्साहजनक परिणाम प्रकट करता है। आंशिक पूर्वकाल क्रूसिएट लिगामेंट संक्रमण (ACLT) को गठिया रोग ग्रसित खरगोश मॉडल को विकसित करने के लिए सफलतापूर्वक किया गया था। हिस्टोपैथोलॉजिकल मूल्यांकन और साइटोकिन्स जीन अभिव्यक्ति ने गठिया के मुराइन मॉडल में सूजन का पता चल गया।

एलएफए को घोड़ियों में गर्भाधारण निदान के लिए विकसित किया गया। शुद्ध एंटी-ईसीजी मोनोक्लोनल एंटीबाडी को कैप्चर एंटीबॉडी और एंटी-खरगोश आईजीजी को संयुग्मित एंटीबॉडी के रूप में इस्तेमाल किया गया।

मारवाड़ी स्टालियन के कुल 1810 वीर्य स्ट्रास और प्रत्येक जांस्कारी और मणिपुरी स्टालियन के वीर्य स्ट्रास को हिमीकृत किया गया है। 29 घोड़ियों को एआई सेवाएं प्रदान की गयी, जबकि अल्ट्रासोनोग्राफी के माध्यम से गर्भावस्था के लिए 35 घोड़ियों की जांच की गई। इसके अलावा 36 वीर्य खुराक (362 स्ट्रास) को क्षेत्र के पशु चिकित्सकों और शिक्षाविदों को एआई को लोकप्रिय बनाने के लिए मुफ्त में वितरित किया गया।

स्टालियन और जैक शुक्राणु गतिशीलता पर कोलेस्ट्रॉल-लोड साइक्लोडेक्सट्रिन (सीएलसी) के प्रभाव का

Study on real-time expression of various fertility related genes *viz.,* SPATA, PLCz, SP17, PRM1, Ubiquitin and CRISP3 have been initiated in this year. The expression of these genes were correlated with the DNA integrity and acrosome integrity and mitochondrial membrane potential. The study also concluded that there was no significant difference in the expression patterns of these genes in breeding as well as non-breeding seasons.

In addition, for the first time epididymal spermatozoa were recovered from stallions that were subjected to gelding by retrograde flushing and float up techniques. The epididymal spermatozoa were successfully cryopreserved and this technique has much potential in preserving the germplasm of elite stallions even after their death.

Phenotypic parameters of 50 of Kachchhi-Sindhi horses were analyzed. Fourteen biometric indices were recorded for phenotypic characterization of Kachchhi-Sindhi horses. PCR has been optimized for eight SNPs pertaining to endurance/fertility in horses. ARMS PCR has been successfully carried out for four SNPs and samples of Marwari, Manipuri, Zanskari and Kathiawari amplified. SNP genotyping/verification by sequencing has been done for six SNPs.

A comparative assay for assessing the total antioxidant activity and ascorbic acid content in donkey (exotic and indigenous) camel, buffalo and sheep milk was carried out. Indigenous donkey milk has more antioxidant activity as compared to exotic (Poitou) donkey milk. Whereas, goat milk showed slightly higher activity than the camel milk and buffalo milk has least antioxidant activity. The Centre has initiated a new vista of developing cosmetics using donkey milk as well as formulations and methodology for making soap and body butter from donkey milk.

A study was conducted to find the effect of feed type and on the occurrence of colic in horses belonging to the Rajasthan, Haryana and Punjab states. It was found that pearl millet and sorghum were associated comparatively more than the lucerne, oats, berseem and maize. Abrupt change of feed/fodder was also identified as important risk factor for colic especially during shifting from dry fodder to green fodder.

Draughtability studies were conducted on Halari donkeys using conventional pneumatic two wheel cart. The study showed that Halari donkeys may pull draft of 33 kg for 3 h, 44, 55, 66 Kg for 2 h, 77, 88 kg for 1 h

मूल्यांकन किया गया। CLC (1 से 2mg/120 x 106 शुक्राणु) की मात्रा में डालने से काफी सुधार हुआ। हिमीकृत शुक्राणुओं 'कोलेस्ट्रॉल: फॉस्फोलिपिड' के अनुपात में कुल एंटीऑक्सिडेंट क्षमता और ऑक्सीडेटिव तनाव को कम करके इस प्रकार बेहतर वीर्य फ्रीज़बिलिटी के रूप में उच्च प्रगतिशील गतिशीलता, एचओएस प्रतिक्रिया, जीवंतता शुक्राणुओं की एक्रोसोमल अखंडता और डीएनए अखंडता द्वारा प्रकट होता पाया गया है।

इस वर्ष में SPATA, PLCz, PRM1, Ubiquitin और CRISP3 जीनों की रीयल टाइम अभिव्यक्ति पर अध्ययन की शुरूआत की गई है। इन जीनों की अभिव्यक्ति डीएनए अखंडता और एक्रोसोम अखंडता और माइटोकॉन्ड्रियल झिल्ली क्षमता के साथ सहसंबद्ध थी। अध्ययन से यह भी निष्कर्ष निकाला कि प्रजनन के साथ-साथ गैर-प्रजनन मौसमों में इन जीनों के अभिव्यक्ति पैटर्न में कोई महत्त्वपूर्ण अंतर नहीं था।

इसके अलावा, पहली बार एपिडीडिमल शुक्राणुओं को प्रतिगामी फ्लशिंग और फ्लोट अप तकनीक द्वारा स्टालियन के बधियाकरण उपरान्त प्राप्त अंडकोष से पृथक किया गया। एपिडीडिमल शुक्राणुओं को सफलतापूर्वक हिमीकृत किया गया और इस तकनीक से अभिजात वर्ग के स्टालियन की मृत्यु के बाद भी जर्मप्लाज्म को संरक्षित करने की बहुत अधिक क्षमता है।

कच्छी-सिंधी नस्ल के 50 घोड़ों के फेनोटाइपिक मापदंडों का विश्लेषण किया गया। कच्छी-सिंधी घोड़ों के फेनोटाइपिक लक्षण वर्णन के लिए चौदह बायोमेट्रिक सूचकांक दर्ज किया गए। घोड़ों में सहनशक्ति/प्रजनन क्षमता से संबंधित आठ एसएनपी के लिए पीसीआर को अनुकूलित किया गया है। एआरएमएस पीसीआर को चार एसएनपी और मारवाड़ी, मणिपुरी, जांस्कारी और काठियावाड़ी के प्रवधित नमूनों के लिए सफलतापूर्वक किया गया है। छ: एसएनपी के लिए अनुक्रमण द्वारा एसएनपी जीनोटाइपिंग/सत्यापन किया गया है।

गधे (विदेशी और स्वदेशी) ऊंट, भैंस और भेड़ के दूध में कुल एंटीऑक्सिडेंट गतिविधि और एस्कॉर्बिक एसिड सामग्री का आकलन करने के लिए तुलनात्मक एस्से किया गया। विदेशी गधे के दूध की तुलना में देसी गधे के दूध में अधिक एंटीऑक्सिडेंट गतिविधि होती है। जबकि बकरी के दूध में ऊंट के दूध की तुलना में थोड़ी अधिक गतिविधि देखी गई और भैंस के दूध में थोड़ी कम एंटीऑक्सिडेंट गतिविधि देखी गई है। केंद्र ने गधी के दूध के साथ-साथ साबुन और बॉडी बटर और कॉस्मेटिक कार्यप्रणाली का उपयोग करके सौंदर्य प्रसाधनों के विकास का एक नया अध्याय शुरू किया है।

राजस्थान, हरियाणा और पंजाब राज्यों से संबंधित घोड़ों में उदरशूल के प्रभाव के बारे में पता लगाने के लिए एक अध्ययन किया गया। यह पाया गया कि लुसर्न, जई, बरसीम एवम् मक्का की तुलना में बाजरे और ज्वार तुलनात्मक रूप से अधिक उदरशूल के प्रभाव से जुड़े थे। विशेष रूप से सूखे चारे से हरे चारे की ओर

without much stress to donkeys as fatigue score was less than 7.

Adjustable saddles and harness for working equines and a customized artificial vagina (AV) for collecting semen from stallions were designed at the Centre. The donkeys were comfortable when using the refined saddle and no injury or saddle marks were observed. This customized AV was found to be user friendly and cost effective, as compared to commercially available AVs.

NCVTC

The activities of NCVTC comprise acquisition, authentication, preservation, documentation, and repository database management system of animal microbes. During the year 2018-19, a total of 267 microbes were accessioned in the repository thereby the cumulative strength of NCVTC reaching to 3746**.** In the bacterial repository 123 bacteria were accessioned during the year, making cumulative culture collection of 1394 bacteria of veterinary importance. In the virus repository, a total of 64 virus isolates were processed, of which 35 viruses were accessioned in the repository. A total of 25 bacteriophages were also isolated from sewage, soil, sludge and farm yard slurry. In rumen microbial repository at NIANP Bengaluru, with the accessioning of 49 rumen bacteria, the total strength of the rumen microbe's repository has reached to 454. With deposition of 36 bacteria, the dairy microbes repository at NDRI, Karnal has also increased its strength to 613 dairy microbes.

Complete genome analysis of two chicken astro-viruses were carried out and revealed that the genome was of 7.5 kb in length and both the isolates were closely related to an isolate previously reported from India (CAstV/INDIA/ANAND/2016). Further, genetic characterization of four strains each of porcine circovirus 2 & 3 (PCV2 & PCV3) were also carried out. The sequence data showed that the genomes of PCV2 contain 1767 nucleotides and shared 95.7 to 99.8 % nt identity with the available PCV2 sequences in database. Genome of PCV3 was found to be of 2000 nucleotide length and shared 97-99.8% nt identity with the PCV3 sequences available in the public database.

Enterobacterial Repetitive Intergenic Consensus-Polymerase chain reaction **(**ERIC-PCR) conducted on 41 *Salmonella* gallinarum isolates revealed that all the 42 isolates were grouped into eight clusters at 80% similarity using PyElph 1.4 software with discriminative power of 0.725.

शिफ्ट करने के लिए फीड़/चारे के अचानक परिवर्तन को महत्वपूर्ण जोखिम कारक के रूप में पहचाना गया।

पारम्परिक न्युमेटिक दो पहिया गाड़ी का उपयोग करते हुए हलारी गधों पर बोझा खींचने की शक्ति का अध्ययन किए गए। अध्ययन से पता चला है कि हलारी गधे 33 किलोग्राम 3 घंटे, 44, 55, 66 किलोग्राम 2 घंटे, 77, 88 किलाग्राम 1 घंटे के लिए तनाव के बिना खींच सकते हैं क्योंकि थकान स्कोर 7 से कम था। बोझा ढोने वाले अश्वों के लिए एडजस्टेबल काठी और हार्नेस तथा स्टालियन से वीर्य एकत्र करने के लिए एक अनुकूलित कृत्रिम योनि (एवी) को केंद्र में डिजाइन किया गया। सुधार युक्त काठी का उपयोग करते समय गधे सहज थे और कोई चोट या काठी के निशान नहीं देखे गए थे। व्यावसायिक रूप से उपलब्ध AV की तुलना में यह अनुकूलित AV लागत प्रभावी, उपयोगकर्ता के अनुकूल पाई गई।

रा.प.प्रा.सं.के.

NCVTC की गतिविधियों में पशु रोगाणुओं का अधिग्रहण, प्रमाणीकरण, संरक्षण, प्रलेखन और रिपॉजिटरी डेटाबेस प्रबंधन प्रणाली शामिल है। वर्ष 2018–19 के दौरान, कुल 267 रोगाणुओं का भंडार में परिग्रहण किया गया, जिससे 3746 की एक संचयी संख्या हो गई। NCVTC में जीवाणु भंडार में, वर्ष के दौरान 123 बैक्टीरिया जमा किए, जिससे पशु चिकित्सा महत्व के 1394 जीवाणुओं का संचयी कल्चर संग्रह हो गया। वायरस रिपॉजिटरी में, कुल 64 वायरस आइसोलेट्स संसाधित किए गए थे, जिनमें 35 वायरस रिपॉजिटरी में परिग्रहण किए गए थे। सीवेज, मिट्टी, कीचड़ और खेत यार्ड स्लरी से कुल 25 जीवाणुभोजी को भी अलग किया गया। NIANP बेंगलुरु में रुमेन माइक्रोबियल रिपॉजिटरी में, 49 रुमेन बैक्टीरिया के अभिग्रहण के साथ, रुमेन माइक्रोब के रिपॉजिटरी की कुल संख्या 454 तक पहुंच गई है। 36 बैक्टीरिया के निक्षेपण के साथ, NDRI में डेयरी रोगाणुओं का भंडार, करनाल ने भी अपनी स्ट्रेंथ 613 तक बढ़ा ली है।

वर्ष के दौरान दो चिकन एस्ट्रो–वायरस का पूरा जीनोम विश्लेषण किया गया और पता चला कि जीनोम की लंबाई 7.5 kb है और दोनों आइसोलेट्स भारत (CAstV / INDIA / ANAND / 2016) से पहले बताए गए एक आइसोलेट से निकट से संबंधित थे। इसके अलावा, चार स्ट्रेनों में से प्रत्येक में आनुवांशिक लक्षण वर्णन 2 और 3 (PCV2 & PCV3) किए गए थे। अनुक्रम डेटा से पता चला है कि PCV2 के जीनोम में 1767 न्यूक्लियोटाइड होते हैं और डेटाबेस में उपलब्ध PCV2 अनुक्रमों के साथ 95.7 से 99.8% एनटी पहचान सहभाजीत करते हैं। PVC3 का जीनोम 2000 न्यूक्लियोटाइड लंबाई का पाया गया और सार्वजनिक डेटाबेस में उपलब्ध PCV3 अनुक्रमों के साथ 97–99.8% एनटी पहचान सहभाजीत की गई।

एंटरो बैक्टीरियल रिपिटिटिव इंटरजेनिक कनसेन्सस–पॉलीमरेज़ चेन रिएक्शन (ईआरआईसी पीसीआर),

Phage antibiotic synergy (PAS) studies using 14 numbers of bacteriophages isolated against mastitis causing bacteria, revealed that many of these phages exhibited PAS effect in presence of different classes of antibiotics against mastitis causing pathogens – mainly Staphylococci. The PAS effect was observed with CEP alone (2 nos.); Penicillin and CEP (2 nos.); CEP, OF and CEC (3 nos.); and CEP and TR (1 no.) overall totalling to 57% (8/14 nos.) of phages.

A new bacteriophage (VTCCBPA119) was isolated against *Klebsiella pneumonia*. The phage was found to be temperature tolerant in the range of 4°C to 55°C and within a narrow pH range of 6 - 9. The biological activity assessment of the phage showed it to be in narrow range spectrum, where it was found to be strongly lytic against only two (2/10) of *K. pneumonia* tested. A new phage against a laboratory induced resistant mutant was obtained. The resistant mutant of *Staphylococcus spp* (RM Fop 171A) was generated.

CRISPR (clustered regularly interspaced short palindromic repeats)/Cas9 technology was exploited to develop knock out HeLa cells deficient in antiviral (anti-HSV1) cellular protein CBX-5. The CBX-5 knockout cells were successfully developed and validated. The CBX-5-KO cell lines showed more sensitivity for herpes simplex virus type 1 (HSV-1) replication.

During 2018-19, the scientists of the Centre published 33 original research articles in international and national refereed journals. In addition, two books, six popular articles, 13 book chapters, 4 extension leaflets and 32 research abstracts were published by the scientists. The scientists of the Centre presented papers in 32 different national and international conferences, seminars or symposia, 25 expert/invited lectures and also participated in 57 workshops and interactive meets in different parts of the country. Seven scientists, two technical and two administrative personnel upgraded their skills by participation in national training programmes while one scientist participated in international symposium. Four scientists including the director recieve fellowship awards etc.

The Centre extended equine welfare activities in different parts of the country by organizing equine health camps and interactive farmer meets to educate equine owners on various aspects of disease control and management. During the year, 2 equine health camps were organized in various parts of Haryana. NRCE adopted 6 villages under 'My Village My Pride'

जो 41 साल्मोनेला गैलिनारम आइसोलेट्स पर अयोजित किया गया था, के द्वारा पता चला कि सभी 42 आइसोलेट्स को 0.725 की विभेदक शक्ति के साथ पायलफ 1.4 सॉफ्टवेयर का उपयोग करके 80% समानता में आठ समूहों में बांटा गया था।

फॉज़ एंटीबायोटिक तालमेल (पीएएस) के अध्ययन में थनों में सूजन पैदा करने वाले बैक्टीरिया के खिलाफ अलग-अलग 14 नंबर के बैक्टीरियोफॉज का उपयोग किया गाय है, जिसमें पता चला है कि इन चरणों में से कई मास्टोजेन के कारण एंटीबायोटिक दवाओं के विभिन्न वर्गों की उपस्थिति में पीएएस प्रभाव दिखाए - मुख्य रूप से स्टैफिलोकोकाई। पीएएस का प्रभाव अकेले CEP (2 नं.) के साथ पेनिसिलिन और सीईपी (2नं.); सीईपी, ओएफ और सीईसी (3 नं.); और सीईपी और टीआर (1नं.) कुल मिलाकर 57% (8/14 नं.) चरणों का देखा गया था।

क्लेबसिएला निमोनिया के खिलाफ एक नया बैक्टीरियोफॉज (VTCCBPA119) अलग किया गया था। यह फॉज़ 4°C से 55°C की सीमा और 6-9 पीएच की संकीर्ण सीमा में तापमान सहिष्णु पाया गया। फॉज की जैविक गतिविधि के आकलन ने इसे संकीर्ण रेंज स्पेक्ट्रम में दिखाया जहां यह पाया गया था कि क्लेबसिएला निमोनिया केवल दो (2/10) के खिलाफ lytic पाया गया। एक प्रयोगशाला प्रेरित प्रतिरोधी उत्परिवर्ती के खिलाफ एक नया फाज़ प्राप्त किया गया था। स्टैफिलोकोकस एसपीपी (आरएस फॉप 171 ए) का प्रतिरोधी उत्परिवर्ती उत्पन्न किया गया।

CRISPR (क्लस्टर किए गए नियमित रूप से छोटे पैलिंड्रोमिक दोहराव को काट दिया जाता है)/ Cas9 तकनीक का उपयोग एंटीवायरल (एंटी-एचएसवी 1) सेलुलर प्रोटीन CBX-5 में हेला कोशिकाओं की कमी को विकसित करने के लिए किया गया। CBX5 नॉकआउट सेल को सफलतापूर्वक विकसित और सत्यापित किया गया। CBX5-KO सेल लाइनों ने हर्पीस सिंप्लेक्स वायरस टाइप 1 (HSV-1) प्रतिकृति के लिए अधिक संवेदनशीलता दिखाई।

2018-19 के दौरान, केंद्र के वैज्ञानिकों ने अंतरराष्ट्रीय और राष्ट्रीय संदर्भित पत्रिकाओं में 33 मूल शोध लेख प्रकाशित किए। इसके अलावा, दो पुस्तकें, 5 लोकप्रिय लेख, 13 पुस्तक अध्याय, 3 विस्तार पत्रक और 32 शोध सार वैज्ञानिकों द्वारा प्रकाशित किए गए थे। केंद्र के वैज्ञानिकों ने 32 अलग-अलग राष्ट्रीय और अंतरराष्ट्रीय सम्मेलनों, सेमिनारों या संगोष्ठियों, 25 विशेषज्ञ/आमंत्रित व्याख्यान में पत्र प्रस्तुत किए और देश के विभिन्न हिस्सों में 57 कार्यशालाओं और इंट्रैक्टिव मीट में भाग लिया। सात वैज्ञानिकों, दो तकनीकी और दो प्रशासनिक कर्मियों ने राष्ट्रीय प्रशिक्षण कार्यक्रमों में भाग लेकर कौशल का उन्नयन किया, जबकि निदेशक सहित चार वैज्ञानिकों ने फैलोशिप प्राप्त की।

scheme - *Mera Gaon Mera Gaurav*. The scientists made 21 visits to these villages and conducted 18 interface meetings and 5 trainings, benefiting 1880 rural families. Two glanders workshops were conducted by the NRCE scientist in Madhya Pradesh during year.

The Centre organized various activities under directives from Government of India. Yoga camp (20-21 June) to celebrate International Day of Yoga, Hindi Fortnight (14-28 September) to promote Hindi, regular and routine Sanitation Drive of the campus, Vigilance Awareness Week (29 October-3 November), World Soil Day (5 December) and World Veterinary Day (28 April). were celebrated. Foundation Day of the Centre and its sub-station was celebrated on 26 November and 28 September, respectively, by organizing Scientists-Veterinarian-Progressive farmers Interface meetings.

Technology development, assessment and transfer to end-users are the mainstay activities of the Centre. During the year, ELISA kits for diagnosis of glanders and EIA were released by the Hon'ble Minister of Agriculture and Farmers Welfare, GoI. LFA for diagnosis of trypanosomiasis and r-protein-based ELISA for the same have been developed. LFA for pregnancy diagnosis in horse mares was developed. MAb based sELISA for EI was developed.

केंद्र ने देश के विभिन्न हिस्सों में स्वास्थ्य शिविरों का आयोजन करके कल्याणकारी गतिविधियों का विस्तार किया और अश्व मालिकों को शिक्षित करने के लिए रोग नियंत्रण और प्रबंधन के विभिन्न पहलुओं पर इंटरैक्टिव किसान बैठकें आयोजित की हैं। वर्ष के दौरान, हरियाणा के विभिन्न हिस्सों में 2 इक्वाइन स्वास्थ्य शिविर आयोजित किए गए। एनआरसीई ने "मेरा गांव मेरा गौरव" योजना के तहत 6 गांवों को अपनाया तथा वैज्ञानिकों ने इन गांवों में 21 दौरे की और 1880 ग्रामीण परिवारों को लाभान्वित करते हुए 18 इंटरफेस मीटिंग और 5 प्रशिक्षण आयोजित किए।

केंद्र ने भारत सरकार के निर्देशों के तहत विभिन्न गतिविधियों का आयोजन किया। योग शिविर, (20–21 जून) अंतर्राष्ट्रीय योग दिवस मनाने के लिए, हिन्दी पखवाड़ा (14–28 सितम्बर) हिन्दी को बढ़ावा देने के लिए, परिसर के नियमित स्वच्छता अभियान, सतर्कता जागरूकता सप्ताह (29 अक्टूबर – 3 नवम्बर), विश्व मृदा दिवस (5 दिसम्बर), विश्व पशु चिकित्सा दिवस (28 अप्रैल) को बड़ी धूमधाम से मनाया गया। केंद्र और उसके उप–स्टेशन का स्थापना दिवस 26 नवम्बर और 28 सितम्बर को क्रमश: वैज्ञानिकों–पशुचिकित्सा–प्रगतिशील किसानों की इंटरफेस बैठक आयोजित करके मनाया गया।

प्रौद्योगिकी विकास, मूल्यांकन और उपयोगकर्ताओं के लिए स्थानांतरण केंद्र की मुख्य गतिविधियां हैं। वर्ष के दौरान, ग्रंथियों और ईआईए के निदान के लिए एलिसा किट्स को कृषि और किसान कल्याण मंत्री, भारत सरकार द्वारा जारी किया गया। ट्रिपैनोसोमियासिस और आर–प्रोटीन अधारित एलिया के निदान के लिए एलएफए विकसित किए गए हैं। घोड़ियों में गर्भ परीक्षण के लिए LFA विकसित किया गया तथा EI के लिए MAB आधारित sELISA विकसित किया गया।

Introduction

Horses have been domesticated since prehistoric times and hold a special place in our history and culture. Domestication of wild horses played a key role in the rise of larger human settlements and great civilizations. The horses have been a symbol of bravery and power since ancient time. In India, the Aryan started domestication of horses and since then many wars were won by cavalry of this species. Mules and donkeys have been a better choice for carrying packs in the mountains and hence are more popularly known as tractor and truck of the hilly tract of the mountain. With the advent of modern means of transportation, utility of equines is decreasing resulting in decline in their population. Horses still remain preferred means of transport in hilly and desert terrains for the rural poor, nomadic tribes in the north, north-west and north-eastern parts of India.

To cater to the needs of equine health and augment equine productivity in the country, Indian Council of Agricultural Research established National Research Centre on Equines (NRCE) on November 26, 1985 at Hisar (Haryana). The main campus of NRCE has state-of-the art laboratories and facilities for undertaking research in areas of equine virology, bacteriology, parasitology, immunology, pathology, medicine, biochemistry and biotechnology. The research activities are supported by centralized services such as animal and agriculture farms, experimental animal facility, microbial containment laboratory, AKMU cell, ATIC, library and Info-equine museum. Subsequently, Equine Production Campus (EPC) was established in 1989 at Bikaner (Rajasthan) to undertake research on equine production, management, genetics and breeding, reproduction, physiology and nutrition. Bikaner campus has well maintained herd of Marwari, Kathiawari, Zanskari and Manipuri horses and Halari donkeys and exotic donkeys. The National Centre for Veterinary Type Cultures (NCVTC) was established in the year 2005 at NRCE, Hisar, for collection and preservation of microbes of animal origin and veterinary importance. Presently, the Centre is working through 14 network units spread throughout the country.

MANDATE OF NRCE

- Basic and strategic research on equine health and production
- To provide advisory and consultancy services and capacity development

OBJECTIVES OF NRCE

- Generation of demand-driven technologies for equine health and production management.
- Capacity building for competitive equine power utilization in agricultural operations to serve the under privileged under changing environment & socio-economic scenario.

SALIENT ACHIEVEMENTS

During past 33 years, NRCE has contributed significantly in the area of diagnosis and control of equine infectious diseases by providing state-of-the-art diagnostics and biologicals. The Centre is striving hard for conservation and characterization of Indian breeds of equines in the country and even established nucleus herds of representative breeds of equines in its Bikaner campus. Some of the achievements and accolades of the Centre are listed below:

Development of diagnostics for equine diseases

The Centre has been recognized as National Referral Centre for diagnosis of important equine infectious diseases by Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Government of India. The Centre has developed and refined diagnostics against various equine diseases:

- HERP kit for field diagnosis of equine

herpesvirus 1 (EHV1) infection.

- A neutralizing monoclonal antibody-based diagnostic kit 'Equiherpes B-ELISA' for EHV1 antibody detection.
- A type-specific ELISA and real-time PCR for differentiation of EHV1 and EHV4 infections.
- Complement fixation and r-protein-based ELISA for diagnosis of glanders.
- A monoclonal antibody-based sandwich ELISA and RT-PCR for detection of equine rotavirus (ERV) from faecal samples.
- RT-PCR and real-time RT-PCR based assays for typing and diagnosis of equine influenza virus.
- A recombinant antigen based-ELISA for detection of antibodies to *Theileria equi*.
- An indirect ELISA using whole cell lysate antigen and PCR for detection of *Trypanosoma evansi*.
- ELISA and RT-PCR for diagnosis of Japanese encephalitis.
- A recombinant protein-based indirect ELISA for serodiagnosis of glanders and equine infectious anemia.
- Lateral flow assay based a rapid diagnostic for *Theileria equi* infection.
- LFA kit for glanders was developed.
- LFA kit for EIA was developed.
- A nested (gB-nPCR) and real-time PCR (gB-qPCR) targeting gB were standardized for detection of EHV1 latency.
- Indirect ELISA was developed using recombinant protein of 444 bp for detection of JEV specific antibodies in horse and pig. The assay has been transferred to NE region labs and is used for validation on pig serum samples.
- Multiplex PCR has been standardized to differentiate *Streptococcus equi subsp equi and zooepidemicus.*
- Lateral flow assay was validated for rapid diagnosis of trypanosomosis using different *T. evansi* antigens.
- ELISA has been developed to detect *T. evansi* antibodies in multiple sps.

Development of vaccines and immuno-biologicals

- Inactivated EHV1 vaccine "Equiherpabort" using indigenous virus for prevention of abortions in mares.
- Updated equine influenza vaccine using indigenous isolate (A/equi-2/Ludhiana/87). The vaccine was updated in 2008-09 incorporating recent virus strain {A/eq/Katra-Jammu.06/08 (H3N8)}.
- Bacterin and outer membrane protein-based vaccine for *Salmonella* abortusequi.
- Monoclonal antibodies against EHV-1, equine rotavirus, equine influenza, Japanese encephalitis and *Trypanosoma evansi*.
- EHV 1 vaccine was formulated with inactivated EHV1 vaccine using montanide adjuvant and tested in murine model for generation of immune response. The modified vaccine is currently under trial in horses.

Basic and Strategic Research

- Generation: CBX5 (HP1) knockout cells were successfully developed by CRISPR/Cas9-mediated genome editing.
- In a preliminary study, HSV1-GFP virus appears to replicate faster in CBX5-KO HeLa cells than WT HeLa cells.
- Additional host genes (Med23/HOXA10/NR3C2) with antiviral functions were knocked out from the HeLa cells. The multiple KO cells are being validated and characterized for their sensitivity to HSV-1 replication.

Surveillance and monitoring of equine diseases in India

- ICAR-NRCE is involved in nation-wide monitoring and sero-surveillance of important equine infectious diseases with a view to manage, control and eradicate diseases. Some of the salient achievements under sero-monitoring include:
- India has gained OIE disease-free status for African horse sickness (AHS) in 2006 based on sero-monitoring data generated by NRCE.
- Clinical cases of equine infectious anemia (EIA) have not been reported since 1997. Only two sero-positive cases (one mule from Uttarakhand in 2009 and one horse from Haryana in 2011) were detected and culled. Control of EIA in India was possible due to timely diagnosis and

implementing package of practices formulated by NRCE.

- Outbreaks of glanders in equines have been detected since 2006-07 from different states and control measures are being adopted for preventing their further spread.
- Effective control of equine influenza outbreak of 1987 (involving 83000 equines) was done by implementing biosecurity and development of effective vaccine. Similarly, a major outbreak of equine influenza that spread in 13 different states of India during 2008-09 and caused huge mortality and economic losses, was timely diagnosed and controlled in collaboration with state animal husbandry departments.

Characterization of equine pathogens

- Nucleic acid sequencing of HA, M, M1 and M2 genes of equine influenza virus (EIV) isolates from 2008 outbreak (A/eq/Jammu-Katra/08, A/eq/Mysore/08 and A/eq/Ahmedabad/09) revealed clustering of Indian and Chinese isolates in a separate cluster designated as "Asian clade" and vaccine updated accordingly.
- Sequencing of VP7 gene of equine rotavirus isolates indicated circulation of G10, G3 and G6 serotypes in India.
- Whole genome sequence analysis of Japanese encephalitis virus isolated from an equine indicated virulent strain of genotype 3 is causing the disease in equine.
- The *in-vitro* cultivation of *Trypanosoma evansi* and *Theileria equi* was successfully established.
- Experimental mouse models for equine influenza and equine herpesvirus-1 infections developed.
- Complete genome sequencing of two EHV1 isolates was carried out using NGS. The primary NGS data obtained covered up to 90% of genome.
- Sequence comparison of Indian EHV1 isolates with other published isolates revealed that Indian isolates are more closely related to EHV1 isolates (OH03 and VA02) from Japan (97.4-98.8%).
- Phylogentic analysis based on US segments classified our isolates into clade 5 along the reference isolates V592.

Phenotypic and genotypic characterization of Indian equine breeds

- Six equine breeds namely, Marwari, Kathiawari, Spiti, Zanskari, Bhutia and Manipuri, have been characterized on the basis of their biometric indices and coat colour.
- High genetic diversity observed between Spiti and Thoroughbred, followed by Spiti and Kathiawari while Zanskari and Manipuri are the least differentiated.
- Indian breeds form three distinctive clusters based on Bayesian analysis: (a) Kathiawari; (b) Zanskari, Spiti & Manipuri ponies and (c) Bhutia.
- Phenotypic parameters of 50 of Kachchhi-Sindhi horses were analyzed.

Establishment of nucleus herd

- ICAR-NRCE has initiated *in-situ* conservation programme in the form of developing an equine sanctuary at EPC, Bikaner where nucleus herds of different Indian horse breeds are being maintained:
- Marwari horses from Rajasthan; Kathiawari horses from Gujarat; Zanskari ponies from Zanskar valley (Jammu & Kashmir) and Manipuri ponies from Imphal (Manipur) and herds of indigenous and exotic donkeys are being maintained:
- Large white (Halari) donkeys for conservation and improvement of donkeys are being maintained.
- Poitou donkey herd for production of superior mules.

Improvement in production potential of equines

- In order to conserve the germplasm of indigenous equine breeds, cryopreservation of semen of Marwari, Kathiawari, Zanskari and Manipur stallions and Halari & Poitou donkeys has been done.
- Artificial insemination using frozen semen has been perfected for production of superior quality horses, mules and donkeys.
- An eCG based sandwich ELISA has been developed for pregnancy diagnosis between days 35 to 120 of gestation in mares.

- Pregnancy diagnosis between days 14 and 18 post-insemination has been perfected using ultrasonography in donkey and horse mares.
- Donkey fibre has been used to produce carpets by mixing with sheep fibres (40:60).
- Studies on assessment of fertility related genes in stallions have been assessed. Expression of SPATA1, PLCz and CRISP3 fertility genes have been studied and established their correlation with DNA integrity and mitochondrial membrane potential of the stallion spermatozoa.

Utilization of equine energy in agricultural activities

- Single animal drawn matching plough, seed drill (two furrow) and harness have been designed and developed for donkeys and mules for agricultural operations like ploughing and sowing.
- The mules have been used for chaff cutting operation with average output capacity of 660 kg/hour of chopped bajra straw in rotary mode chaff cutter.
- Draughtability studies conducted on adult donkeys using conventional pneumatic two wheel cart showed that Halari donkeys may pull draft of 33Kg for 3 hour, 44, 55, 66 Kg for 2 hour, 77, 88 Kg for 1 hour without much stress to donkeys.
- The technique of vermicomposting of equine dung has been optimized for use in agricultural fields.

Patents granted

- Nano-drug delivery for quinapyramine sulphate (Patent No.310429, Application, No.2560/DEL/2011, dated 06.09.2011).

Patents filed

- A highly sensitive kit for detection of antibodies against *Theileria equi* in serum of equids. Application No. 2763/DEL/2012 dated 06.09.2012
- Nano-drug delivery for quinapyramine sulphate. Application No.2560/DEL/2011, dated 06.09.2011.
- Polynucleo-desequence, processes, composition and methods thereof. Application No. 1575/CHE/2010 and PCT/IB 2011/052475.
- A recombinant haemagglutinin domain containing protein for the detection and diagnosis of glanders and method of preparation thereof. Application No. 1328/DEL/2010 dated 08.06.2010.
- Recombinant *Tss*A protein for detection of antibodies against *Burkoholderia mallei* and uses thereof. Application No. 3610/DEL/ 2015.
- Recombinant *Hcp*1 protein for detection of antibodies against *Burkoholderia mallei* in Equines. Application No. 4120/DEL/ 2015.
- *Aerva javanica* extract for the treatment of exuberant granulation tissue and tumors in horses. Application No.201811048899, dated 24.12.2018. (Provisional).
- Polymeric metal nanocomposites and methods of synthesis thereof Application No. 201911009696, Dated 13.03.2019

Services

ICAR-NRCE provides following services to the farmers and equine breeders:

- Disease diagnostic services for various infectious and non-infectious diseases to equine owners, breeders, state animal husbandry departments, police and army horses.
- Surveillance, monitoring and control of equine infectious diseases in India.
- Health certification for movement of equines within and outside the country to promote export of horses.
- Clinical and diagnostic (including pregnancy diagnosis) services for equine diseases.
- Artificial insemination to augment the production of superior quality horses, mules and donkeys.
- Provision of quality jacks and jennies to various states, breeding societies and farmers, for production of superior quality mules and donkeys.
- Onsite and online consultancy in equine health and production, including toll-free telephonic advisory at Hisar and Bikaner campuses for farmers and stakeholders.
- Trainings and supply of education materials for equine management, production and health.
- Education and awareness of equine farmers by

organization of health camps, awareness campaigns and farmers meets in different areas of the country.

National Centre for Veterinary Type Cultures

National Centre for Veterinary Type Cultures (NCVTC) initiated its activities in 2005 for conservation of the microbial diversity of animal origin. The activities comprise acquisition, authentication, preservation, documentation, and repository database management system of animal microbes. A network programme is in operation with 14 network units located in 9 different states *viz*., Haryana, Rajasthan Uttar Pradesh, Himachal Pradesh, Assam, Tamil Nadu, Gujarat, Kerala and Karnataka. These network units are contributing in conservation of animal microbial diversity in three specialized areas: veterinary microbes at NRCE Hisar, dairy microbes at NDRI, Karnal and rumen microbes at NIANP, Bengaluru.

MANDATE OF NCVTC

- National repository of veterinary, dairy and rumen microorganisms and their identification, characterization and documentation.
- Distribution of microbes for teaching, research and development of new technologies.

OBJECTIVES OF NCVTC

- Exploration and collection of microorganisms of animal origin/significance/relevance
- Central storage of animal microbes from existing culture collection centres, institutions and universities
- Characterization, documentation and digitization of microbial database of cultures of animal microbes
- Development of a National Microbial Gene Bank for conserving the biodiversity of animal microbes
- Conservation (both short-term and long-term) and utilization of microorganisms.

The activities of NCVTC comprise acquisition, authentication, preservation, documentation, and repository database management system of animal microbes. During 2018-19, a total of 267 microbes were accessioned in the repository leading to a cumulative strength of 3746. In the bacterial repository at NCVTC, 123 bacteria were accessioned during the year, making cumulative culture collection of 1394 bacteria of veterinary importance. Some of the important bacterial isolates accessioned include: *Achromobacter denitrificans*, *Aeromonas hydrophila, Raultella ornitholytica, Salmonella* Typhimurium, *Aeromonas caviae, Comamonas testorenii, Pediococcus acidolactici, Vibrio parahaemolyticus, Paenibacillus alvei, Aerococcus urinae equi, Lactococcus taiwanensis, Streptococcus minor, Streptococcus equi, Rhodococcus equi, Mannheimia caviae* and *Mannheimia hemolytica.* In the virus repository, a total of 64 virus isolates were processed, of which 35 viruses were accessioned in the repository. The important virus isolates accessioned include, *Peste des petits ruminants* virus, Bovine herpes virus-1, Newcastle disease virus, Fowl adenovirus, Canine adenovirus, Classical swine fever virus, Bluetongue virus and Fowlpox virus. During the current year, emphasis was on the isolation and characterization of bacteriophages against pathogens of mastitis: *Staphylococci* spp., and *Streptococci* spp. A total of 8 bacteriophages were isolated from sewage, soil, sludge and farm yard slurry. In rumen microbial repository at NIANP Bengaluru, with the accessioning of 49 rumen bacteria, the total strength of the rumen microbe's repository has reached to 454. With deposition of 36 bacteria, the dairy microbe's repository at NDRI, Karnal has also increased its strength to 613 dairy microbes.

The distribution of microbes for teaching, research and development of new technologies is another mandated activity of NCVTC. In this regard, bacterial cultures *Aeromonas hydrophila, Bacillus cereus*, *Salmonella* Paratyphi, *Salmonella* Typhimurium, *Bacillus subtilis, Streptococcus agalactiae*, *Listeria monocytogenes* and *Pseudomonas aeruginosa;* two viruses (Bluetongue virus and Infectious bursal disease virus); and four cell lines (BHK-21, MDCK, A-72, Vero) were distributed to different Institutes/Universities in India for research and teaching purposes. Some of the salient achievement of NCVTC are listed below.

Veterinary Microbes

- First laboratory confirmed camelpox virus zoonosis.
- First report on isolation and genetic characterization of swinepox virus from India
- Accessioning of vaccine strains of viruses *viz.,* Peste des petits ruminants virus, Sheeppox (Srinagar strain), Goatpox virus (Uttarkashi

Table: Year-wise progression of microbial cultures at NCVTC

Microbes	2009-14	2014-15	2015-16	2016-17	2017-18	2018-19	Total
Veterinary Microbes							
Bacteria	700	227	110	164	70	123	1394
Virus	135	21	14	28	27	35	260
Bacteriophage	13	19	44	29	24	8	137
Recombinant clone	326	140	45	10	36	16	573
Phage library	27	--	--	--	--	--	27
Genomic DNA	176	47	57	0	8	0	288
Total	**1377**	**454**	**270**	**231**	**165**	**182**	**2679**
Rumen microbes							
Anaerobic bacteria	101	41	74	37	37	49	339
Fungi/Yeast	104	3	0	0	0	0	107
Meth. Archae	8	0	0	0	0	0	8
Total	**213**	**44**	**74**	**37**	**37**	**49**	**454**
Dairy microbes							
Bacteria	**432**	36	39	40	30	36	613
Total	**432**	36	39	40	30	36	613
Grand Total	**2022**	**534**	**383**	**308**	**232**	**267**	**3746**

strain), Orf virus (Mukteswar strain), NDV (R2B strain) and NDV (F strain).

- Complete genome sequencing of Classical swine fever virus (2), chicken astro virus(2) & porcine circo virus (4) .
- First isolation and characterization of *Bordetella bronchiseptica*, *Actinobacillus equilli, Staphylococcus hyicus*, *Trueperella pyogenes.*
- Whole genome sequencing of *Pasteurella multocida* sub spp. *multocida* B:2 serotype.
- First isolation and identification of *Moraxella (Branhamella) ovis* from ovine keratoconjunctivitis in sheep and methicillin-resistant coagulase negative *Staphylococcus sciuri* from goats.
- Whole genome sequencing of *Trueperella pyogenes, Bordetella bronchiseptica, Pasteurella multocida, Actinobacillus equuli* and *Salmonella* Gallinarum.
- Accessioning of rare strains of bacteria: *Campylobacter* spp., *Bacillus megaterium, Enterococcus casseliflavus, E. cecorum, Barrientosiimonas humi, Corynebacterium amycolatum, Enterococcus devriesei, E. hirae, E. faecium, Nocariopsis alba, Ignatzschineria larvae* and *Escherichia hermanii.*
- Isolation of bacteriophages against a variety of pathogenic bacteria was added to NCVTC repository, including a novel thermotolerant bacteriophage isolated from Ganga river water.

Rumen Microbes

- Isolation and characterization of seven tannin degrading bacteria-*Streptococcus gallolyticus* from goat, fibre degrading bacteria *Ruminococcus flavefaciens, Prevotella* sp. and *Butyrivibrio* sp. from buffaloes and cattle, and nitrate reducing and cellulose degrading *E. coli* from buffalo.
- Isolation of rumen fungi - *Anaeromyces* sp., *Orpinomyces intercalaris* and *Orpinomyces joyonii* from buffaloes; *Piromyces* sp. and *Neocallimastix* sp. from goats.

Dairy Microbes

- Preservation of dairy microbes, viz, *Lactobacillus* spp., *Lactococcus* spp., *Lactococcus lactis* ssp. lactis, *Lactococcus lactis*. ssp. Cremoris, *Lactococcus lactis* ssp. lactis bv. Diacetylactis, *Streptococcus*

thermophilus, *Leuconostoc* sp., *Bifidobacterium* sp. *Bifidobacterium dentium*, *Bifidobacterium longum, Micrococcus* sp., *Kluyveromyces lactis* and *Saccharomyces bisporus*.

- Combination of *L. lactis* ssp lactis-C12 and *Leuconostoc mesenteroides* ssp. mesenteroides is very suitable for curd and buttermilk preparation.
- Six *Lactobacillus* sp. having phytase degrading potential and strong antifungal activity have been isolated form milk-cereal fermented products (Rabadi samples).
- An amylytic strain of *Pediococcus acidolactici* isolated has potential as starter culture in preparation of milkcereal fermented products.

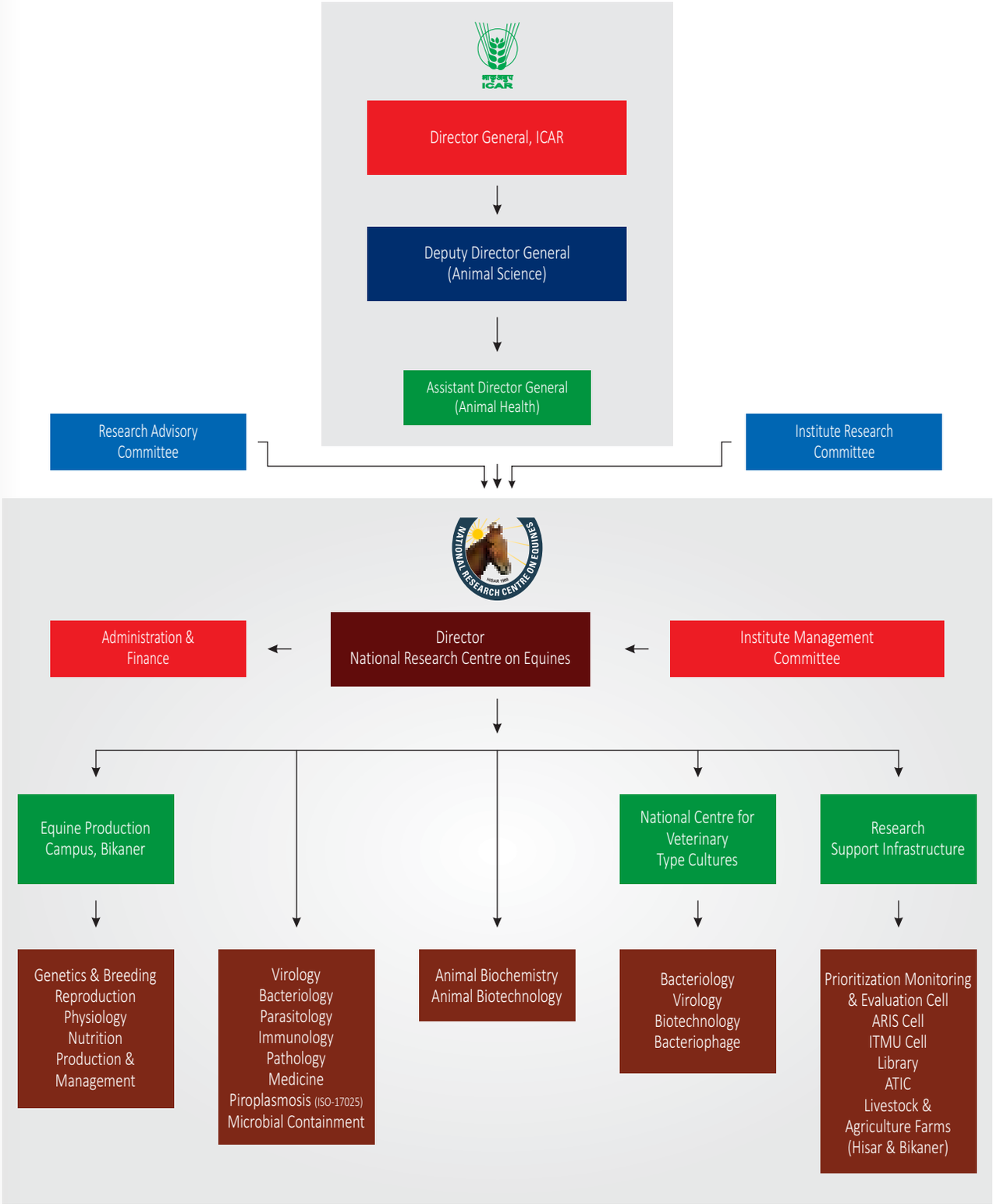
SUMMARY OF EXPENDITURE & REVENUE GENERATION

	2017-18 Rs. in Lacs	2018-19 Rs. in Lacs
Summary of Expenditure		
Establishment charges including LSP/PF, wages, OTA	908.88	1276.17
Travelling allowances & HRD	13.05	24.64
Others charges including equipments & recurring charges	827.81	927.36
Works	54.52	71.43
Loans and Advances	2.50	0.0
Total Plan Expenditure	**1806.76**	**2299.6**
Summary of Revenue Generation		
Sale of farm produce	5.29	15.47
Sale of livestock	0.65	0.59
Sale of publications and advertisements	0.18	0.0
License fee	1.47	1.98
Interest on loans and advances	3.94	4.72
Interest on short term deposits	17.24	26.69
Contractual diagnostic services	53.97	61.54
Receipt from services	0.0	0.0
Other miscellaneous receipts	22.37	91.56
Eco-tourism	3.50	6.21
Total	**108.61**	**208.76**

STAFF POSITION AT NRCE & NCVTC

Name of the Post	NRCE			NCVTC		
	Sanctioned	Filled	Vacant	Sanctioned	Filled	Vacant
Director	1	1	0	-	-	-
Scientific	26	14	12	10	7	3
Technical	23	21	2	-	-	-
Administrative	14	11	3	-	-	-
Supporting	22	20	2	-	-	-

Organizational Structure of NRCE



Research Achievements

Equine Viral Diseases

Characterization of genetic diversity among equine herpesvirus-1 (EHV-1) isolates from India

Complete genome sequences of EHV-1 isolates from India are lacking. During the year, whole genome sequencing and bioinformatics analysis of two EHV-1 isolates (EHV-1/Hisar/2014 and EHV-1/Meerut/2014) using NGS were carried out. The primary NGS data obtained so far covered upto 90% of genome including all the ORFs in the unique long (UL) and unique short (US) regions (except ORF 23, which was incomplete). The sequences were conserved in most of the regions; however, some nucleotide changes (transition and transversion) were observed in the different ORFs (nt changes varied from 1 to 5). A total of 43 ORFs depicted nt changes; among these maximum nt changes (n=5 each) were observed in the ORFs 24, 33 and 43. We could also observe some deletion in the repeat regions of ORF 24 which codes for the tegument protein (Fig 1). Deletions were also observed in the terminal repeats of UL segments (between ORF 63 and 64), however, this needs to be confirmed by re-sequencing.

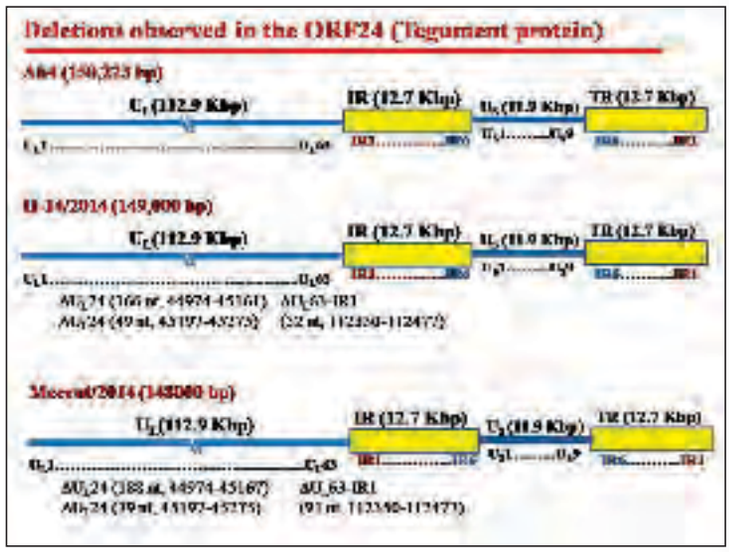


Fig 1: Deletions observed in the ORF24 (Tegument protein)

The EHV-1 viruses have been classified into 13 viral clades based on the complete genome analysis and this method has been found to be better as compared to the previous classification which was based on the sequence diversity at ORF68 region. Sequence comparison of Indian EHV-1 isolates with other published isolates revealed that Indian isolates are more closely related to EHV-1 isolates (OH03 and VA02) from Japan (97.4-98.8%). Phylogentic analysis based on US segments classified our isolates into clade 5 along with the reference isolates V592.

(BR Gulati, Riyesh T & Naveen Kumar)

Development of nested and real-time assay for detection of EHV-1 latency

In order to diagnose latent EHV-1 infection, nested (gB-nPCR) and real-time PCR (gB-qPCR) targeting glycoprotein B (gB) were standardized. EHV-1 gB-nPCR amplified a 188 bp size fragment of glycoprotein B gene of EHV-1. The assay sensitivity was determined to be 1340 fg or 4.1 x 103 gene copies. For gB-qPCR, standard curve was generated with serial 10-fold dilutions of EHV-1/V592 DNA template. From the standard curve, the slope was calculated as -3.658 and the correlation coefficient (R2) was found out to be 0.999. By using obtained Cq value and slope, the amplification efficiency was calculated to be 87.7%. The sensitivity of the real-time assay was found to be 13.4 fg or 41 copies. Both the assay was found to be specific for EHV-1 and did not react with other equine DNA viruses viz. EHV-4/Hisar and EAdV/H9.

Relative sensitivity and specificity of the gB-nPCR assay for EHV-1 latency was estimated by comparing wit that of gB-qPCR for detection of EHV-1 gB. The sensitivity and specificity of gB-nPCR were 46.66% and 100%, respectively (Table 1). The findings establish that the real-time PCR is a sensitive and specific assay for ante mortem detection of EHV-1 latency in equine population.

Table 1: Sensitivity of gB-nPCR vs gB-qPCR to detect latent infection based on 24 EHV-1 latently infected mares

Screening Test	Results	gB-nPCR		Sensitivity (%)	Specificity (%)
		Pos	Neg		
gB-qPCR	Pos	7	8	46.66 (21.27-73.41)	100 (66.37-100)
	Neg	0	9		

qRT-PCR is more than 200% sensitive than nested RT-PCR and highly specific

(BR Gulati, Nitin Virmani & Himanshu Sharma)

Development of deletion mutants of equine herpes virus-1 (EHV-1) using bacterial artificial chromosome (BAC) technology

EHV-1 is an economically important disease of equines and warrants effective control program. We have been working towards development of modified live vaccine and various mutants are being developed for investigating their attenuation followed by protective efficacy. In this process we have generated transfer cassettes for deletion of IR6, pUL43 and pUL56 genes. The transfer cassettes were constructed having a kanamycin-resistance (kanR) coding sequence and 50 bp overlapping regions of targeted genes (IR6, pUL43 and pUL56) separately. The various deletion mutant EHV-1-BAC constructs were generated employing red 1 & red 2 based mutations following En passant mutagenesis strategies. The EHV-1-BAC clone in E.coli were electroporated with the various transfer cassettes for 1st red recombination to incorporate the kana cassette in place of targeted region followed by screening of recombinant EHV-1-BAC clone against kanamycin and confirmation by colony PCR. Subsequently, the confirmed 1st red clones were subjected to 2nd red recombination step to remove kana cassette and screened clones by replica platting. The deletion mutant clones were confirmed by colony PCR and RFLP analysis of mutant EHV-1-BAC DNA using different restriction enzyme digestion (Fig 1).

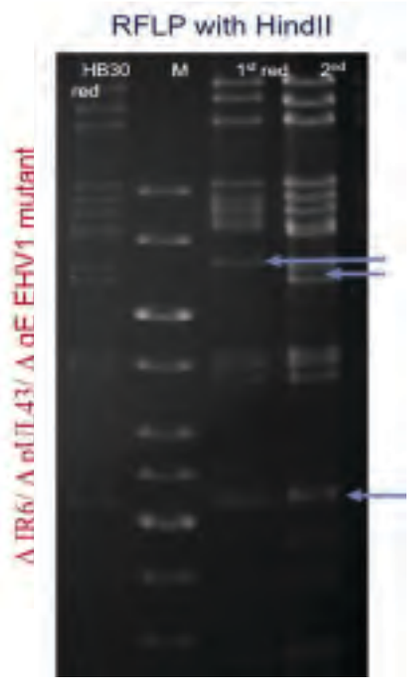


Fig. 1 : RFLP for IR6, pUL43 and gE deletion mutant of EHV1

The plasmid DNA of deletion mutant EHV-1-BAC clones were purified and subjected to digestion using different restriction enzymes. The RFLP patterns were compared with the fragments of original virus and EHV-1-BAC construct. The deletion mutants were confirmed by visualization of expected banding patterns having some addition and deletion of bands in comparison to the wild virus and EHV-1-BAC. The mutant EHV-1-BAC plasmids were purified and transfected into RK13 cells and viruses with green fluorescence plaques were observed ~48 h after transfection (Fig 2). This further confirmed the successful generation of deletion mutant EHV-1 viruses.

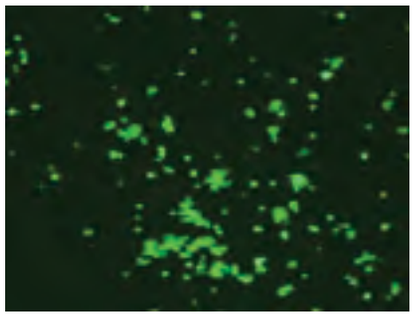


Fig. 2 : CPE of IR6+ pUL43+gE+pUL56 EHV1 mutant virus at 96 hours post-infection in RK13.

The growth kinetics of mutant EHV-1 viruses were estimated by inoculation of mutant and wild type viruses into RK13 at a moi of 0.01 followed by adsorption for 1 h and washing with PBS to remove unbound virus. At indicated time points (At 0, 12, 24, 48, and 72 after inoculation) the titres of the viruses were calculated by standard plaque assays using serial 10-fold dilutions of each virus in triplicate in RK13 cells. The growth pattern of the mutant virus (intra-cellular and extracellular) titres was reduced as compared with parental strain.

(Nitin Virmani, BC Bera, Taruna Anand & BN Tripathi)

Monoclonal antibody based sandwich ELISA for equine influenza

Equine influenza is an OIE listed disease of equines caused by H3N8 influenza A viruses. Currently clade 1 and 2 viruses of Florida sublineage are responsible in majority of the outbreaks globally. Traditionally, the gold standard diagnostic test for equine influenza is virus isolation from nasal swabs but time-consuming and dependent on the presence of viable virus. Similar is the situation for serological identification by haemagglutination inhibition assay, which is also an OIE recognized assay. RT-PCR, qRTPCR have been developed for detection of equine influenza, however, their use is limited to specialized laboratories only. Enzyme immunoassays and lateral flow assays for antigen detection are required and are being utilized world over for faster and precise diagnosis in less sophisticated laboratories. With this intent we initiated development of a monoclonal antibody based sandwich ELISA kit for detection of EI antigen. Monoclonal antibody (1B10) was utilized for the assay. For standardization of the procedure allantoic fluid positive for EIV from A/eq/Jammu-Katra/06/08 was utilized at various titres (64 - 0.025 HA units) and incubated at 37ºC for 60 min in the wells. The cut-off level was estimated as the mean absorbance of negative allantoic fluid, plus three standard deviations (SDs). The detection limit of the assay was found up to 1HA unit. Further, viruses/ antigens belonging to various linages were spiked in nasal swabs and tested. The assay was able to detect the viruses from all the lineages barring H7N7 and a small reduction in OD for the antigen from Miami/63 virus. Further the shelf life testing of the assay and its validation are in progress

(Nitin Virmani, Taruna Anand, BC Bera & BN Tripathi)

Reverse genetics engineered 6:2 reassortant equine influenza (H3N8) virus produces influenza like disease in mouse model

A recombinant equine influenza virus generated through reverse genetics engineering and having a backbone of H1N1 (WSN/33 system) and HA and NA segments from H3N8 belonging to Clade 2 of Florida sublineage isolated from an outbreak of 2008-09 in India. Comparative pathological studies of the recombinant virus versus the wild EIV were carried out in murine model. BALB/c mice (n = 30), 4–5 weeks of age were divided into three groups viz. Group I–RG EIV inoculated (n = 15) and Group II – Wild virus inoculated (n = 15) and mock infected (n=15). Group I and II mice were inoculated with $2\times10^{6.24}$ EID_{50} EIV of both viruses in 20 µl volume through intranasal route, while group III mice were mock inoculated with 20 µl of allantoic fluid harvested from healthy embryonated chicken egg. Mice were monitored closely for the presence of clinical signs and bodyweight loss. EIV inoculated mice (n = 3) and mock inoculated mice (n = 3) were euthanized at intervals–1, 3, 5, 7 and 10 dpi by cervical dislocation. Recombinant virus (6:2) constructed employing reverse engineering technology and wild virus had more or less similar clinical signs which initiated with respiratory distress and crouching at corners from 2 dpi (days post infection) onwards. The clinical signs included forced expiration, ruffled coat and crouching at the corners between 3 & 5 dpi. Severity of the clinical signs increased up to 7 dpi followed by a progressive decline and no clinical signs were observed at 10 dpi. Appearance of clinical signs in mice was in concurrence with reduction in body weights and maximum body weight reduction was observed on 3 & 5 dpi (~6%). Lung lesions were characterized by red hepatization appreciated from 1 dpi

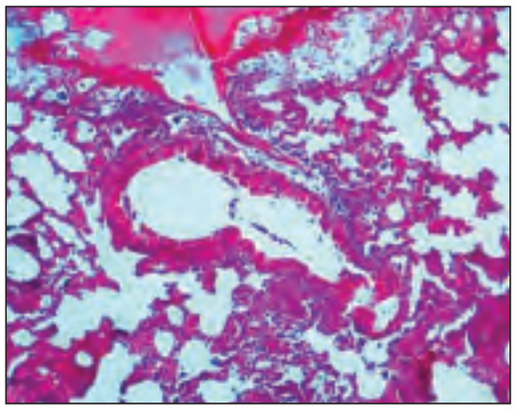


Fig 1: Section of lung at 5 dpi, showing hyperplasia of bronchiolar epithelium and necrosis along with peribronchial as well as diffused infiltration of lymphocytes H.E.100X

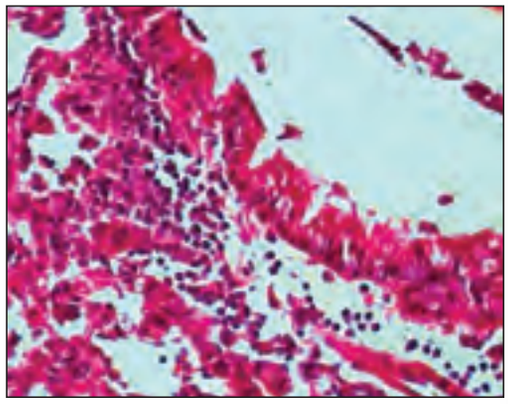


Fig 2 : Section of lung at 5 dpi, showing bronchiolar epithelium and necrosis along with peribronchial as well as diffused infiltration of lymphocytes H.E.400X

onwards. At 3 dpi, lungs showed larger area of red hepatization and it had changed to mild gray discoloration by 5 dpi. Areas of consolidation were focal in nature in both the groups and could be observed till 7dpi. No clear lesions could be seen in any of the mice from group 1 and 2 at 10dpi. Mock inoculated mice (Group III) did not show any lung lesion throughout the period of the experiment. Histopathological studies revealed congested blood vessels, infiltration of neutrophils followed by lymphocytes and macrophages. Necrosis in lung parenchyma and desquamation of bronchiolar epithelium initiating from 1 dpi onwards in lungs (Fig 1 & 2). There were no remarkable differences in lesions in RG virus group vs wild EI virus.

(Nitin Virmani, Taruna Anand, BC Bera & BN Tripathi)

Scheduling-Glanders and Equine Infectious Anemia (EIA) using Point of Care Diagnostic (PoCD)

Large scale productions of recombinant proteins (Hcp1, TssA, TssB and p26) were optimized in 5 litre fermenter. Yield of protein was in the range of 150- 200 mg/L. By using these recombinant proteins indirect ELISA kits and lateral flow assay for Glanders and EIA was developed (Fig. 1). Working protocols with step-by-step instructions was developed for validation purpose. These kits were tested in house with the sera panel and found 98% sensitivity and 99% specificity (Fig. 2). Hyper immune sera were raised in mules for all the four recombinant proteins to use as positive controls with each kit. In house accelerated assays were carried out following the SOPs as per OIE/FDA guidelines and observed the life expectancy of the ELISA will be 18 months to two years if kept at 4ºC for ELISA. In the next phase, kits will be validated by third party in 8 diagnostic laboratories in India and in OIE Reference Laboratory on Glanders, Germany; European Union Reference Laboratory, France.

Fig.1: EIA and iELISA kits developed for the detection of glanders

Fig. 2 : Lateral Flow Assay for glanders and EIA diagnosis.

(H Singha & BN Tirpathi)

Equine Bacterial Diseases

Seroproteome analysis of recombinant secretory proteins of *Burkholderia mallei* towards development of multiple antigen immunoassay for improved diagnosis of glanders

A study was conducted for identification of diagnostic antigen(s) and development of multiple antigen based serodiagnosis of glanders. *B. mallei* secretory protein database (DBSecSys 2.0; http://dbsecsys.bhsai.org/dbsecsys/home.xhtml) was used to identify various secretory proteins of *B. mallei*. A total of 24 secretory proteins belonging to T2SS, T3SS, T5SS and T6SS secretory systems of *B. mallei* were identified from DBSecSys 2.0

database. Selected secretory proteins are involved in various biological activities such as interference with the immune response, intracellular, survival, virulence, apoptosis, phagosomal escape and evasion of autophagy, etc. These secretory proteins were used for epitope mapping and designing of six chimeric fusion proteins. The custom designed gene(s) were commercially synthesized in cloning vector and subsequently sub-cloned into prokaryotic expression vector for production of recombinant proteins. Two fusion proteins were produced in *E. coli* (Fig 1). These purified proteins will be verified by Western Blot using glanders positive and negative sera.

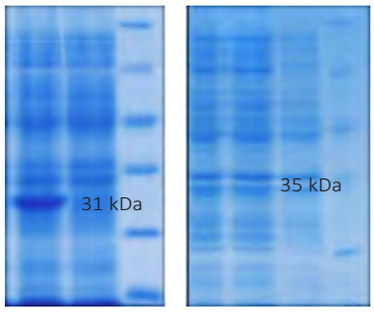


Fig. 1: Expression of two recombinant chimeric proteins of Burkholderia mallei.

(Harisankar Singha, K Shanmugasundaram, Sheetal Saini & BN Tripathi)

Prevalence and associated risk factors of *Rhodococcus equi* infection in foals of Rajasthan

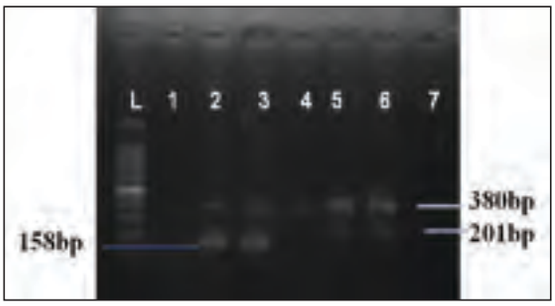
To study the prevalence and associated risk factors of *Rhodococcus equi* in the foals in the desert, semi desert and canal irrigated areas of north western and west Rajasthan we have collected fecal swabs in triplicate from 100 foals belonging to Bikaner, Jaisalmer, Jodhpur, Pali, Sriganganagar, Hanumangarh, Sikar, and Jhunjhunu districts of Rajasthan and out of them 18 samples were found positive for pathogenic Vap A & Vap C genes. So on the basis of results of this study it can be stated that 18% of foals (age <12 months) in these areas are positive for the fecal shedding of pathogenic *Rhodococcus equi* bacteria.

Age of foal, foaling month and number of horses at stable were compared with the faecal shedding of *R. equi*. It was observed that the highest incidences of *R. equi* was found in the foals born in month of July, about 63% foals born in this month were bearing *R. equi* in their feces. In present study, all 18 positive cases were found in the stud farms having 15 or more horses. Out of them, 3 cases were found clinically ill. Age of the clinically ill foals ranged between 1-6 months of age. Total leucocyte count was >15000 and Neutrophil, percent was above 75 in all the clinically ill cases. It was also observed that foals reared on sandy soils have more chances to get infection. Regular change of barn soil with fresh soil was observed as most important measure to control *R. equi* faecal shedding foals.

(D Barsiwal, RK Dedar, L Kumar, A Chahar, Sanjay Kumar & BN Tripathi)

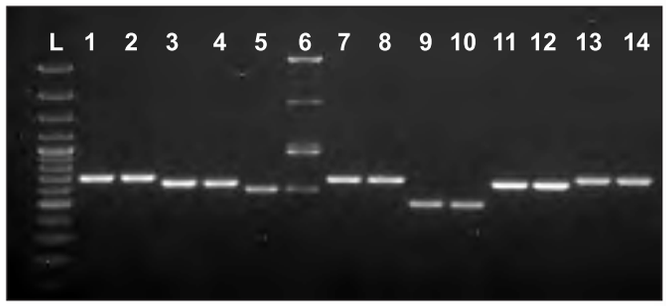
Diagnosis and sequence typing of *Streptococcus equi strains*

Nucleic acid based multiplex PCR was standardized to diagnose and differentiate *Streptococcus equi subsp equi and zooepidemicus.* Twenty eight isolates of *S. equi* and *S. zooepidemicus* revived from the repository were confirmed by multiplex PCR (Fig.1). Seven housekeeping genes Carbamate kinase (arcC), Ribonucleoside-diphosphate reductase (nrdE), Prolyl-tRNA synthetase (proS), Signal peptidase I (spi), Thymidylate kinase (tdk), Triosephosphate isomerase (tpi) and Acetyl-CoA acetyltransferase (yqiL) of 28 isolates of *Streptococcus equi* were also amplified, purified and sequenced (Fig. 2). These are being analyzed further to assign Multi Locus Sequence Types (MLST) to study the diversity amongst Indian isolates of *S. equi.*



L: 100 bp DNA ladder; 1 & 7. Negative controls; 2-6: 380 bp, *Streptococcus sp.;* 2-3: 158 bp *S. zooepidemicus;* 4: *Streptococcus sp* other than *S. equi and S. zooepidemicus;* 5-6: 201 bp *S. equi*

Fig: 1. Multiplex PCR has been standardized to differentiate *Streptococcus equi subsp equi and zooepidemicus*



L: 100 bp DNA ladder; 1 & 6; Housekeeping genes 1-5 & 7-14

Fig: 2. Amplification of seven house-keeping genes, sequencing, allelic profiling and multilocus sequence typing

(Balvinder Kumar, RK Vaid, Anju Manuja, K Shanmugasundram & H Singha)

Disinfection of farm soil against *Rhodococcus equi* using plant leaves

A study was carried out to find a herbal disinfectant for farm soil to prevent aerosol infection of *Rhodococcus equi* in foals. *Tamarindus indica* and *Eucalyptus globulosa* leaves's aqueous extracts were tested *in-vitro* against Vap A and Vap C positive *R. equi*. (Fig.1) Aqueous extracts of both the plants were found having antibacterial activity against *R. equi*. Powder from plants leaves (*Tamarindus* and *Eucalyptus)* obtained from both the plants were boiled with water and concentration 10 % W/V and more were found effective to disinfect the farm soil which was given infection with Vap A and Vap C positive *R. equi*.

Control – *R. equi* *R. equi* colony – yellow colour	10% W/V boiled water with *Eucalyptus globulus* leaves powder; *R. equi* colony – absent	10% W/V boiled water with *Tamarindus india L.* leaves powder; *R. equi* colony – absent

Fig. 1: Antimicrobial activity of *Tamarindus indica* and *Eucalyptus globulus* leaves' boiled water in presence of farm soil.

(RK Dedar, L Kumar, D Barsiwal, Sanjay Kumar, RA Legha, T Rao, SC Mehta & BN Tripathi)

Equine Protozoan Diseases

Development and validation of lateral flow assay for rapid diagnosis of trypanosomosis using recombinant antigens

Presently, whole cell lysate antigen-based ELISA and PCR assays are routinely used for diagnosis of animal trypanosomosis (surra). But these assays have limitations for use at field level due to lack of required infrastructure/facility. Hence, there is an increasing demand from field veterinarians, farmers and other stakeholders for development of a user friendly, rapid and specific diagnostic kit which may be used for routine screening of this disease at the door-step of farmers.

In the present study, the recombinant proteins *viz.*, Flagellar, ISG and Tandem repeat Ag were expressed and purified. The LFA strips were prepared using these recombinant antigens individually, cocktail of these three antigens and also WCL antigen for validation of assay. For determining diagnostic sensitivity and specificity, 100 reference samples (50 positive and 50 negative) based on test results of WCL-ELISA were used. The results revealed sensitivity of LFA ranged from 48.48%-89.53% at 95 % CI with different antigens. The diagnostic sensitivity and specificity of WCL-LFA, ISG-LFA and cocktail Ag LFA yielded comparatively better results for antibodies detection against *T. evansi* infection. The TR-LFA was found to be least sensitive (Fig 1).

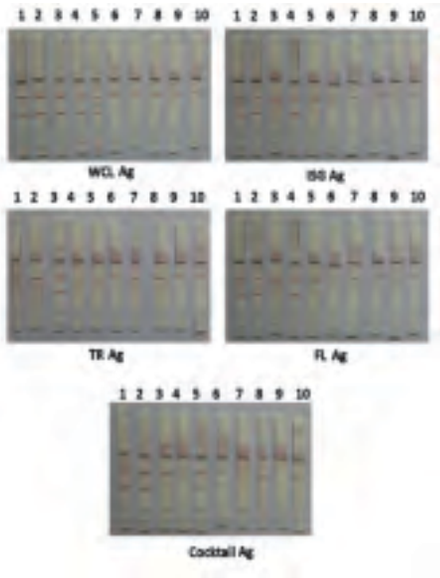


Fig.1: Results of LFA using different recombinant proteins for detection of antibodies against *T. evansi* infection.

(Rajender Kumar, Sanjay Kumar and BN Tripathi)

Pathology of *Trypanosoma evansi* infection induced immune complexes in rabbits

In earlier studies, antibody persistency in *T. evansi* infected equines was observed for more than one year after successful treatment. This might be due to deposition of antigen in various tissues as immune complexes. In the present study, pathology of immune complexes in rabbit model was studied.

Histopathological studies in experimentally *T. evansi* infected and treated rabbit revealed diffused hemosiderosis in the spleen; congestion of blood vessels in the lung; congestion of blood vessels, hydropic degeneration of hepatocytes, bile duct hyperplasia and infiltration of lymphocytes and neutrophils in the liver. In brain, no pronounced pathological lesions were observed. In kidney, the lesions were more prominent comprising thickening of glomerular membrane, thickening of vascular endothelium, perivascular infiltration of lymphocytes, eosinophilic cast in proximal convoluted tubules (Fig.1). Immunohistochemical IFAT study of kidney tissues revealed strong fluorescence on endothelium of blood vessels indicating presence of *Trypanosoma* antigen (Fig.2). The fluorescence was also observed in the glomerulus tuft of kidney. The deposition of immune complexes on endothelium of kidney blood vessels and glomerulus tuft might be resulting in to triggering of immune response upon release of antigen from Ag-Ab complexes and leading to persistent antibody titre for a longer period in treated animals suffering from *T. evansi* infection.

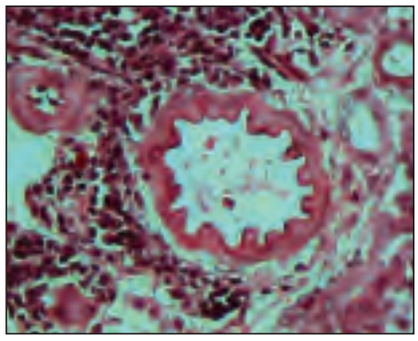


Fig.1: Section of kidney of infected/treated rabbit showing vascular endothelial thickening, peri vascular infiltration of lymphocytes (60X).

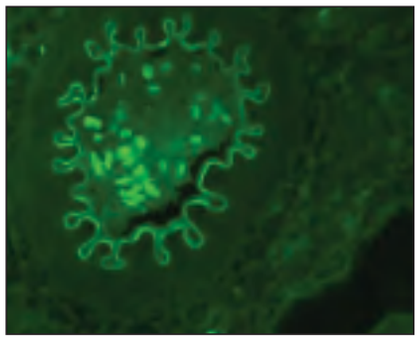
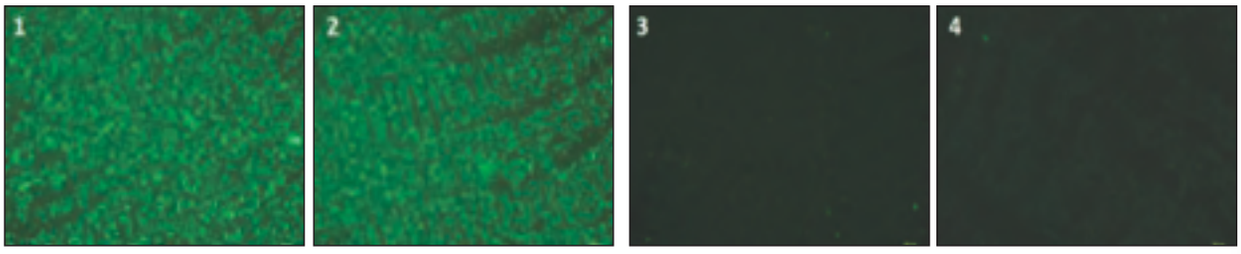


Fig. 2 : Section of kidney of infected/treated rabbit showing fluorescence on endothelium of blood vessels indicating deposition of Ag-Ab complexes (60X).

(Rajender Kumar, Sanjay Kumar & Nitin Virmani)

Indirect fluorescent antibody test developed for diagnosis of *Theileria equi* infection

Theileria equi infection is of major economic importance as significant segment of the Indian equine population (~35%) is latently infected. Diagnosis of sub-clinical *T. equi* infection is of more relevance as these animals' aid in spread of the parasite to naïve animals. These latently infected animals may become clinically infected in the event of physical/immunological/mental stress. Previously, ICAR-NRCE developed ELISA based diagnostic kit for diagnosis of *T. equi* infection. The laboratory has developed MASP in vitro cultivation system for propagation of T. equi protozoa. As per OIE guidelines there was a need to develop IFAT diagnostic for *T. equi* diagnosis. We prepared IFAT slides from in vitro cultured *T. equi* infected RBC and optimized the protocol. A total 204 serum/blood samples were tested in IFAT, LFA, ELISA and MASP in vitro culture system and 137, 140, 148 and 124 samples were detected positive, respectively (Fig. 1-4). Further previously developed rapid diagnostic (LFA) was also tested on filed samples and a total 477 samples were tested and compared with ELISA. A total 286 samples were tested positive in ELISA while 266 samples were detected positive in LFA.



***Theileria equi* positive** ***Theileria equi* negative**

(Sanjay Kumar & Rajender Kumar)

Drug Development & Delivery

Growth inhibitory efficacy of herbal plant extracts against *Theileria equi*

The equine piroplasmosis is a haemoprotozoan disease of horses, mules, donkey and zebras. The two protozoan parasites named *Theileria equi* and *Babesia caballi* are the etiological agents for this disease condition. The Indian medicinal plants are well recognised as traditional and alternative therapy since vaidik civilization. Scientific validation of Indian medicinal plants for claimed therapeutic usage is a challenge and we undertook this preliminary study for documenting their anti-piroplasmic activity. Last year, anti-*T. equi* activity of methanolic extract of herbal plant (AN/NRCE/MED) was demonstrated. The methanolic extract was further chromatographed in silica (60-200μ) column to yield 8 fractions. All the 8 fractioned were tested for there *in vitro* activity against *T. equi*. Out of these, ANMEA/NRCE/MED fraction was most effective in inhibiting the growth of parasite with IC_{50} of 33.56 μg/ml. The cytotoxic potential of the fraction was investigated on host PBMCs and RBCs by using resazurin viability dye and osmotic fragility assay. The viability on PBMCs cells was recorded at IC_{50} of 222.2 μg/ml. The selectivity was improved by 1.62 times than its crude extract counterpart. The thin layer chromatography was performed to identify the active fractions/lead molecules present in the ANMEA/NRCE/MED fraction. Four separate spots were visible on the TLC plate. The gallic acid and catechin were identified as lead molecules by comparing the R_f values of the extract with standard compounds (Fig. 1). The ANMEA/NRCE/MED fraction is in the process of further fractionation and purifying the active lead molecules and spectroscopic identifications.

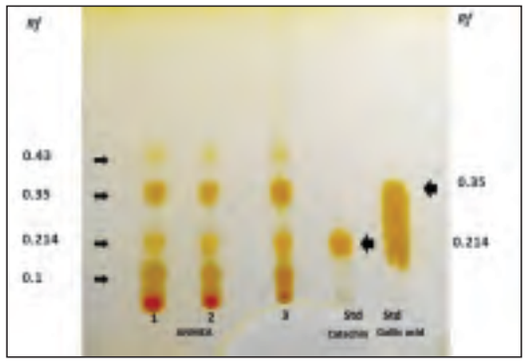


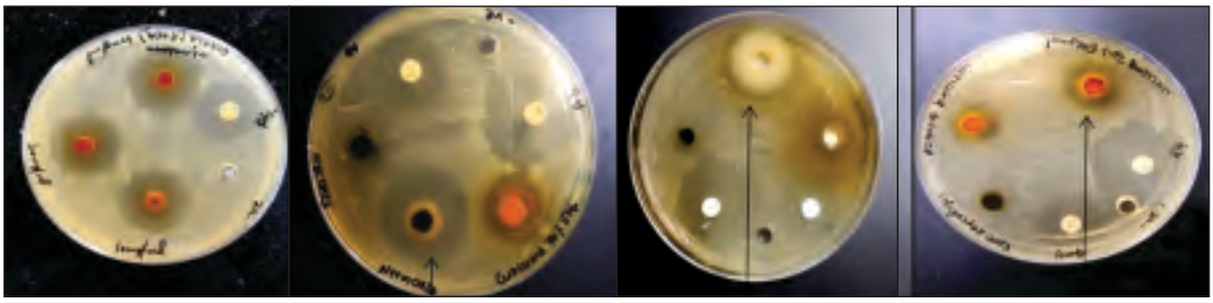
Fig. 1: Thin layer chromatograph of ANMEA/NRCE/MED fraction tested against *T. equi*

(Sanjay Kumar & Rajender Kumar)

In vitro anti-*Rhodococcus equi* activities by some herbal plant's extracts and its prevalence

Pneumonia is a major cause of disease and death in foals. *Rhodococcus equi*, a Gram positive facultative intracellular pathogen, is one of the most common causes of pneumonia in foals. Although *R. equi* can be cultured from the environment of virtually all horse farms, the clinical disease in foals is endemic at some farms, sporadic at others, and unrecognized at many. On farms where the disease is endemic, costs associated with morbidity and mortality may be very high. The *R. equi* prevalence rate in farms were evaluated by collecting blood, nasal swabs, fecal swabs from an organized stud farm. The complete haemato-biochemical analysis was performed and isolation of *R. equi* was also undertaken. A study on prevalence of *R. equi* in the foals in the desert, semi desert and canal irrigated areas of north western and west Rajasthan was carried out by collecting 100 fecal swabs were collected from Bikaner, Jaisalmer, Jodhpur, Pali, Sriganganagar, Hanumangarh, Sikar and Jhunjhunu districts of Rajasthan. Eighteen samples were found positive for pathogenic vap A & vap C genes of *R. equi* by PCR analysis. A comprehensive study is going on effect of herbal plants by taking extracts of Tulsi leaves, Neem Bark, Basanga leaves, Chandan leaves, *Tinospora* stem, *Nyctanthus* leaves, *Phyllanthus* whole plant, *Acacia nilotica* bark for *in vitro* anti-*R. equi* activity. Different extracts of 12 herbal plants were screened for their anti-*R. equi* activity in vitro by agar well diffusion assay at a concentration of 100 mg/ml according to CLSI (Clinical & Lab Standards Institute) protocol. Rifampicin and erythromycin antibiotics were taken as positive controls. After 24 hours of incubation zone of inhibition in mm was measured and the plants with larger diameter of zone of inhibition were selected for further research analysis. The chloroform extract of *Azadirachta indica* leaves (29.5 ± 0.5mm), *Acacia nilotica* bark (29.25 ± 0.75mm) and methanolic extract of *Terminalia chebula* (26.5 ± 0.5mm) showed better activity in comparison to reference antibiotics (Fig. 1). Minimum inhibitory concentration (MIC) was determined by a CLSI protocol as per resazurin microtitre plate assay. The lowest concentration at which change occurred was taken as MIC value. All the three plants namely *Azadirachta, Terminalia* and *Acacia nilotica*, showed MIC

value at 625 ug/ml in comparison to rifampicin. The effect of different herbal drugs at various concentrations on mammalian cell was determined by resazurin based cytotoxicity assay on PBMCs separated from whole blood of a healthy horse. The viability of PBMCs cells were 84.98%, 82.12% and 86.50% for *A. indica*, *A. nilotica* and *T. chebula* respectively at 500 ug/ml. The total phenol estimations of *A. indica*, *A. nilotica* and *T. chebula* plant were 47.4 μg, 91.3 μg and 483.6 μg of catechin equivalent per mg of extract. Similarly, total flavonoid estimation results reveled presence of 67.39 μg, 124.84 μg and 52.88 μg of catechin equivalent per mg of extract. The presence of the phytochemicals is responsible for the antibacterial activity.



Acacia chroroform extract	Neem chroroform extract	Terminalia methanolic extract	Curcuma 70% ethanol

Fig 1: Muellar Hinton Agar plates showing zone of inhibition formed by different plants extracts.

(Sanjay Kumar, Ramesh Dedar, Rajesh Vaid & Harishankar Singha)

Fabrication of novel zinc-iron based polymeric nanocomposites and evaluation on equine fibroblasts

We have described a simple and rapid method to synthesize metal oxide nanoparticles providing an assortment of nanoparticles resembling flower like structure (Fig.1). The novel method of synthesis of polymeric metal oxides demonstrated a much higher yield as compared to conventional methods. Primary equine fibroblast cells grown in Dulbecco's Modified Eagle Medium (DMEM) supplemented with FBS and antibiotics were seeded in 2 ml quantity in a 12 well tissue culture plates at a density of 1×10^5 cells/ml and grown in a 5% CO_2 incubator at 37°C. Fibroblast cells were treated with optimized concentration of nanoformulations (AGZnO NPs, CS ZnO NPs, Fe doped ZnONps, ZnONps), DMSO 10μM and untreated cells were kept as controls. It was observed that all cultures treated nanoformulations proliferated well with 70% to 85% confluency except that for DMSO suggesting biocompatability and non-cytotoxicity of the nanoformulations, whereas DMSO (known for its toxicity) treated cells exhibited 15% confluency indicating detrimental effects on cells (Fig.2).

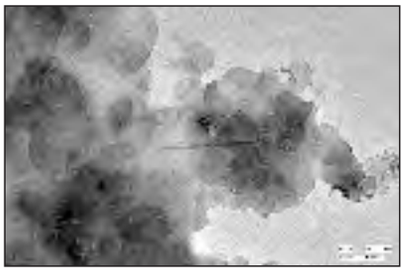


Fig.1: Morphology of ZnO Nps and Fe-doped ZnO Nps as determined by transmission electron microscopy

Fig. 2: Effects of nano-formulations on horse fibroblasts

(Anju Manuja, Balvinder Kumar, Riyesh T & BN Tripathi)

Sero-surveillance of Equine Diseases

Sero-surveillance of Equine Infectious Diseases in India

Surveillance and monitoring of emerging and existing equine diseases have been a regular and continuous activity of the institute. During 2018-19, 1170 equine serum samples from 10 states were tested for various diseases like

Equine Infectious anaemia, Equine Influenza, EHV-1, JEV, Trypanosomosis, Piroplasmosis, *Salmonealla* Abortus equi and Brucellosis (Table 1). Total number of positive and seropositive percentage for various diseases were 556 (47.25%) for *Theileria equi*, 208 (17.77%) for EHV-1, 51 (4.35%) for *Trypanosoma evansi* and 73 (6.23%) for JEV. None of the equines were found positive for equine influenza, equine infectious anemia, brucellosis and *Salmonella* Abortusequi.

Table 1: Seroprevalence of important diseases of indigenous equines.

State	EIA	EI	*T. evansi*	EHV-1	*T. equi*	JE	Sal. Ab. equi	Brucellosis
Madhya Pradesh	103	103	103(1)	103(8)	103(60)	103 (2)	103	103
Rajasthan	29	29	29	29	29 (15)	29(1)	29	29
Uttar Pradesh	338	338	338(9)	338(42)	338(206)	338(17)	338	338
Jammu & Kashmir	362	362	362(36)	362(138)	362(171)	362(3)	362	362
Uttarakhand	40	40	40(1)	40(2)	40	40	40	40
Tamil Nadu	84	84	84	84(12)	84(20)	84(3)	84	84
Haryana	129	129	129(4)	129(4)	129(65)	129(46)	129	129
Delhi	2	2	2	2	2	2	2	2
Himachal Pradesh	61	61	61	61(1)	61(13)	61	61	61
Chhattisgarh	22	22	22	22(1)	22(6)	22(1)	22	22
Total	**1170**	**1170**	**1170 (51)**	**1170 (208)**	**1170 (556)**	**1170 (73)**	**1170**	**1170**
Sero-positive (%)	**0.0**	**0.0**	**4.35**	**17.77**	**47.52**	**6.23**	**0.0**	**0.0**

(Number in parenthesis indicates seropositivity)

Disease investigation

Under disease investigation 24001 equine sera was tested for glanders at NRCE and 13557 samples were tested by six State Diagnostic laboratories using ELISA supplied by NRCE. Out of 37558 samples tested 338 were found positive for glanders. Glanders cases were from Uttar Pradesh (243), Rajasthan (3), Maharashtra (8) Uttarakhand (7), Gujarat (20), Haryana (9), Jammu & Kashmir (4), Himachal Pradesh (3), Madhya Pradesh (30), Delhi (9) and Tamil Nadu (2) states were found positive under disease investigation (Fig.1). In public health point of view, 198 human serum samples from in contact /equine handlers were tested and all of them were negative for glanders. In addition, testing of 681 samples for equine influenza revealed that all the samples were negative for H3N8 antibodies. For EIA, 39 serum samples were tested and found to be negative by Coggin's test. For AHS, 77 random samples from 5 states were found negative. While 33 samples tested for EHV-1 antibodies were also found negative.

Table 2: No of sample tested under disease investigation

Disease	No of samples	No positive
Glanders	37558	338
EI	681	-
EIA	39	-
AHS	77	-
Theileria equi	6	-
T. evansi	2	-
EHV-1	33	-

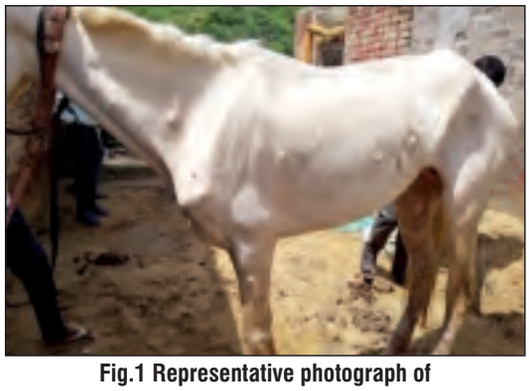


Fig.1 Representative photograph of glanders affected horse

Microbiological analysis was done on 277 clinical samples *viz.,* nasal swabs, tissue, abscess, aborted fetus etc. collected from Rajasthan, Haryana, Uttar Pradesh, Himachal Pradesh, Gujarat, Odhisa, Tamil Nadu and Delhi yielded 72 isolates including *Klebsiella pnuemoniae* (9), *E.coli* (18), *Rhodococcus equi* (5) *Enterococcus* spp (7), *Streptococcus* spp (20), *B. mallei* (15), Rota Virus and *T. equi* (Table 3).

Table 3: Bacteria, viruses and parasites isolated from 277 bio-samples

Organism	No.	Place
Burkholderia mallei	15	Uttar Pradesh (7), Delhi (2), Haryana (2), Tamil Nadu (2) & Maharashtra (2)
Klebsiella pneumoniea	9	Uttar Pradesh (1), Haryana (4) Rajasthan (4)
E. coli	18	Rajasthan (14), Haryana (3), Uttar Pradesh (1)
Streptococcus zooepidemicus	11	Uttar Pradesh (4), Rajasthan (3), Uttar Pradesh (1), Uttarakhand (1), Haryana (2)
Streptococcus equi	3	Tamil Nadu
Rhodococcus equi	5	Haryana
Streptococcus spp	2	Uttar Pradesh (1), Rajasthan (1)
S. equisimilis	4	Haryana
Enterococcus spp	2	Uttar Pradesh (1), Haryana (1)
Rota Virus	1	Rajasthan
Theileria equi	2	Gujarat

(H Singha, BN Tripathi, SC Yadav, BR Gulati, Rajender Kumar, Sanjay Kumar, N Virmani, Sanjay Barua, RK Vaid, RK Dedar, Anju Manuja, Balvinder Manuja & K Shanmugasundaram)

Assessment of risk factors of colic and laminitis

A study was conducted to find the effect of feed type and on the occurrence of colic in horses belonging to Rajasthan, Haryana and Punjab states. The horses which were being kept round the year on dry fodder were allowed to graze in rainy season. It was found that pearl millet and sorghum were associated comparatively more than the lucerne, oats, berseem, maize in causing colic in horses. Abrupt change of feed/fodder was also identified as important risk factor for colic especially shifting from dry fodder to green fodder. In this duration, total 4 cases of colitis were also occurred and all were associated with jowar (sorghum) feeding. In this duration, 3 cases of laminitis were found and all were associated with uterine infection.

Table 1: Occurrence of colic cases in association with different green fodder

Fodder	Jowar	Wild Grass	Lucerne	Pearl millet	Oats	Berseem	Maize	Only dry fodder with seasonal grazing
Colic cases	39	12	1	4	0	0	0	5
Colic %	63.93	19.67	1.64	6.56	0.00	0.00	0.00	8.20
% of horses fed	32.89	19.28	27.11	2.39	4.18	1.60	0.64	11.92
Fodder % colic	1.94	1.02	0.06	2.74	0.00	0.00	0.00	0.68

(RK Dedar, RA Legha, T Rao, SC Mehta & BN Tripathi)

Seroprevalence and molecular epidemiology of JEV in Assam

Seasonal distribution of JE sero-positivity among pigs in Assam was evaluated from February 2017 to December 2018. A total of 1357 pigs from eight districts of Assam in different seasons were tested for JEV antibodies and 228 (16.80%) were detected positive, indicating high JEV seropositivity in pig population of the region. Serum samples collected were tested for JEV antibodies by Indirect ELISA, haemagglutination inhibition and virus neutralization. In the present study higher number of pig sero-positivity was recorded in Jorhat district (20.65 %) as compared to Kamrup (16.31%) and Lakhimpur (12.78 %).

A total of 149 whole blood samples and 78 tissue samples were collected from different pig farms and were also screened for JEV by RT-PCR. The envelope protein of JE virus was targeted by RT-PCR. A total of 21 blood samples and 9 tissue samples were JEV positive by RT-PCR. RT-PCR positive amplicons were sequenced commercially and the sequence analysis revealed 100 % identity with envelope proteins of human and equine JEV isolates from West Bengal, Vellore, Haryana and Lucknow.

(BR Gulati)

Equine Production

Development of LFA for pregnancy diagnosis in mares

Presently, there is no lateral flow assay (LFA) available in the market for rapid pregnancy diagnosis in mares. LFA was developed using hyperimmunesera (HIS) and monolclonal antibodies (mAbs) raised in our laboratory. Equine chorionic gonadotropin (eCG) at capture concentration of polyclonal antibody at 1.0, 2.0 and 3.0 mg/ml were tested and is being further optimised. mAbs are working perfectly as conjugate antibody at 3 mg/ml and 10 OD concentration. For optimization of LFA various serum dilutions were tested and it was observed that undiluted serum gave better visibility at test line. Purified anti-eCG mAb as capture, purified anti-eCG mAb as conjugate and anti-rabbit IgG as control will be used to sharp the control line both in positive and negative samples and sharp the test line in positive samples. Now, some private partner will be contacted, so that at least 1000 LFA devices could be made for field testing.

(Yash Pal & Sanjay Kumar)

Blood and biometric parameters analysis in Kachchhi-Sindhi horses

The Kachchhi-Sindhi horses are recently recognized as seventh breed of Indian horses. This indigenous horse breed is native to Kachchh district of Gujarat and Jaisalmer and Barmer districts of Rajasthan. Total population of these horses is about four thousand only. The unique features include roman nose appearance of face, ears curved at tips but not touching each other (unlike Marwari and Kathiawari horses), about 56 to 60 inch height, short back, short pastern bone length, broader hoof for better grip and docile temperament. Coat colour is mainly bay. These horses are famous for its 'Rewal chal' as it performs with great speed and stamina covering long distance. The horse possess excellent drought and heat tolerance capacity in arid & semi arid region. For analysis of major phenotypic characters the morphometeric data was collected from non-relative Kachchhi-Sindhi horses of Jaisalmer (Rajasthan) and Bhuj (Gujarat). About fourteen biometric indices were recorded for phenotypic characterization of Kachchhi-Sindhi horses *viz.,* height at wither (HW), heart girth (HG), body length (BL), Neck length (NL) face length (FL), face width (FW), ear length (EL), ear width (EW), hoof length (HoL), hoof width (HoW), fore leg length (FLL), canon, pastern and pole (Table 1 ; Fig.1). Animals of both sexes were included in this study. All the parameters recorded were non-significantly different in the stallions (n=12) and mares (n=31). Most prevalent colours in Kachchhi-Sindhi horses were bay and chestnut. Nose bone of these horses is raised at its middle and dropping sharply at the end of nostrils may be called parrot nose. Ears are straight and remain apart all the time.

Table: 1. Biometric indices of Kachchhi –Sindhi horses

Parameters	HW	HG	BL	NL	FFL	Canon	Pastern
Stallion (12)	147.75±1.41	162.36±1.92	139.00±1.31	45.73±0.67	103.82±1.07	24.95±0.43	11.63±0.43
Mare (31)	147.71±0.96	165.88±1.59	139.95±1.39	46.65±1.09	103.15±0.55	24.98±0.31	11.80±0.31

Parameters	FL	FW	Pole	EL	EW	HfL	HfW
Stallion (12)	60.50±1.11	17.50±0.49	13.95±0.35	14.40±0.36	16.20±0.35	12.54±0.32	11.10±0.25
Mare (31)	60.82±0.44	18.59±0.29	14.65±0.33	15.63±0.21	16.15±0.17	12.07±0.16	11.48±0.13

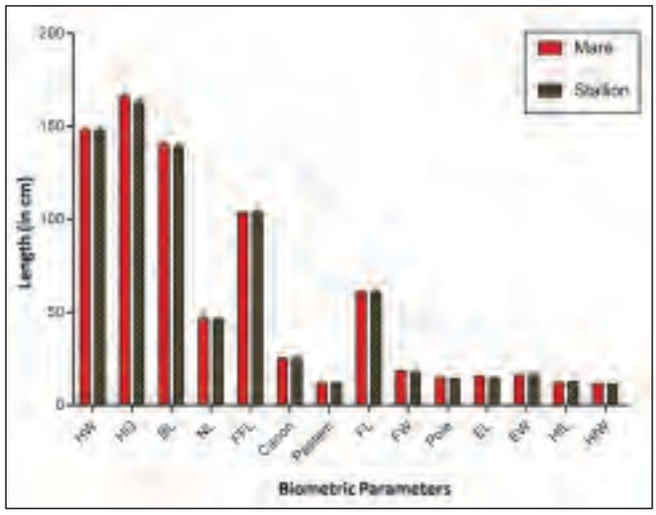


Fig.1: Biometric indices of Kachchhi –Sindhi horses

Biochemical profiles are widely used in animals including equines for disease diagnosis and prognosis in evaluating their physical soundness and performance efficiency. Serum albumin, total protein (TP), direct bilirubin (BID), total bilirubin (BIT), cholesterol, urea, uric acid, triglyceride and calcium were analyzed. BID, BIT, uric acid, calcium and albumin were significantly ($P<0.05$) different in adult Kachchhi-Sindhi stallions and mares irrespective of area of sample collection whereas total protein, blood urea, triglycerides and cholesterol was non-significantly different. BIT, uric acid and calcium were significantly ($P<0.05$) different in Kachchhi-Sindhi males and females irrespective of age and area of sample collection whereas BID, albumin, total protein, blood urea, triglycerides and cholesterol was non-significantly different. BIT content was significantly ($P<0.05$) higher in stallions than mares of Kachchhi-Sindhi breed belonging to Kutch district of Gujarat. Albumin content was significantly ($P<0.05$) higher in stallions than mares of Kachchhi-Sindhi breed belonging to Jaisalmer district.

(Anuradha Bhardwaj, Yash Pal & SC Mehta)

Endurance and fertility analysis in indigenous horses using SNP markers

ARMS (Amplification Refractory Mutation System) – PCR standardised for four SNPs associated with endurance or fertility. Three SNPs *viz.,* BIEC2_11782, BIEC2_755603, BIEC2_363958 were associated with endurance and one SNP FKBP6_2 was associated with fertility. A representative gel photograph of ARMS-PCR for SNP FKBP6_2 is presented below. The ARMS-PCR was standardised as 49 samples belonging to Marwari, Kathiawari, Manipuri and Zanskari were genotyped. Fifteen samples with known genotype were sent for sequencing. Quality results were obtained for 14 samples. The sequencing results confirmed the genotyping done by ARMS-PCR (Fig. 1).

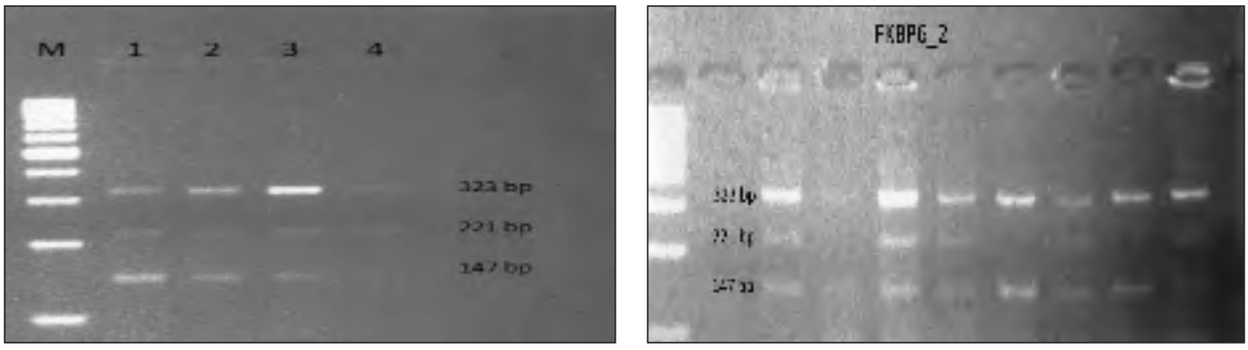


Fig. 1: Amplification of main band and allelic bands by ARMS-PCR

(SC Mehta, RK Dedar, TR Talluri & SK Ravi)

Effect of addition of cholesterol-loaded cyclodextrins (CLC) on stallion and jack sperm motility

Cryopreservation process induces alteration in the temperature and causes membrane alteration by lipid loss and lipid/protein rearrangements within the sperm membrane. A way to improve the semen quality is to prevent the sperm cryoinjury during freezing process is the addition of cholesterol which controls sperm membrane structure by interacting with the phospholipid hydrocarbon chains thus making the membrane more stable at temperatures below the phase transition. Addition of CLC (1 to 2 mg/120×10^6spermtaozoa) significantly improved 'Cholesterol: Phospholipid' ratio of cryopreserved spermatozoa by reducing the total antioxidant capacity and oxidative stress thus resulting in better semen freezability as revealed by higher progressive motility, HOS response, livability, acrosomal integrity and DNA integrity of spermatozoa. Optimum beneficial effects on semen cryopreservation was observed at dose rate of 2.0 mg CLC/ 120×10^6spermtaozoa but detrimental effects were observed at the dose rate of 3 mg CLC/120×10^6spermtaozoa.

(SK Ravi, Pramod Kumar & TR Talluri)

Study of follicular dynamics, AI and cryopreservation of semen

The follicular dynamics were studied in all three breeds of mares during breeding and non-breeding seasons. Estrus cycle was monitored in 12 Marwari and 5 Zanskari and 3 Manipuri mares, respectively. A significant difference was observed in number of follicles in ovary at estrus and size of the mature follicle at ovulation in all three breeds of mare's *viz.,* Marwari, Zanskari and Manipuri (Table 1). A significant difference in the ovulatory follicle size was observed between breeds and within the breed also and the ovulatory follicle size ranged from 36.58±0.57 to 51.84±1.64 mm.

Table 1. Follicular dynamics of three indigenous horse breeds

Breed	No. of Mares	Length of estrus cycle (Days)	Estrus duration (Days)	Pre-Ovulatory follicle size (mm)	Conception %	Average cycles/ Conception	No. of AI/ Conception
Marwari	14	21.45±0.76	7.61±0.71	42.58±4.51[a]	85.71	1.88	2.82
Manipuri	3	22.97±0.91	10.34±0.48	37.75±1.57[c]	33.33	2.96	3.85
Zanskari	5	21.51±1.41	9.32±1.34	39.92±1.18[b]	100	1.98	1.94

Semen from six Marwari, three of each Zanskari and Manipuri stallions have been collected and 1810 semen straws of Marwari and 570 semen straws of each Zanskari and Manipuri stallions have been cryopreserved during the current year. A total of 64 field mares visited the centre for the artificial insemination (AI) and pregnancy diagnosis purpose. AI services have been provided to 29 mares and 35 mares were diagnosed for pregnancy through ultrasonography and a total of 36 doses (362 semen straws) were distributed free of cost to the field veterinarians and to the academicians for spreading AI in Equines.

(TR Talluri, SK Ravi & J Singh)

Isolation and cryopreservation of stallion epididymal spermatozoa

Two farm stallions were subjected for gelding. The testicles from these stallions were recovered surgically and the epididymis was isolated carefully. Two methods i.e. retrograde flushing and float up techniques (Fig. A and B) were effectively applied to recover spermatozoa from the stallion epididymis. A comparative study between the seminal parameters from the epididymal spermatozoa and semen from normal collection were done and found that there was no significant difference in the progressive motility and viability of the spermatozoa. The isolated spermatozoa were successfully cryopreserved using conventional methods of freezing and will be used in near future for inseminating the farm mares to obtain pregnancy.

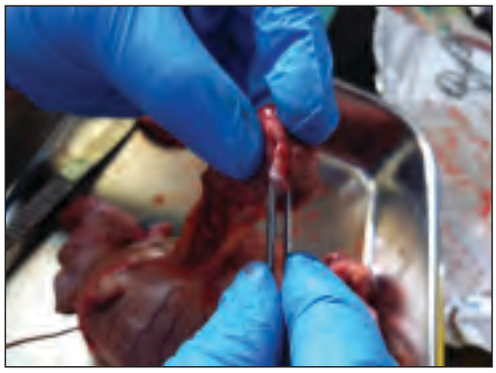


Fig.A : Retrograde flushing.

Fig. B : floating up techniques of epididymal spermatozoa

(TR Talluri & Dinesh Jhamb)

Database preparation and estimation of inbreeding coefficient of farm herd

Inventory database has been used for the identification of unrelated animals at the farm. The inventory database of the horses of the Equine Production Campus (EPC) has been prepared and updated for the period 1989 to 2019, i.e. from date of inception of the EPC to till date. The pedigree of the equines at the Centre has been prepared and is being used in preparation of breeding plan. The entire period of about 30 years was divided in to 6 tiers for the calculation of inbreeding in the Marwari herd. In all, 182 records were available for calculation of relationship /inbreeding coefficient of the Marwari herd. The analysis was carried out using the software Pedigree Viewer 6.5, written by Brian and Sandy Kinghorn of The University of New England. The inbreeding had been bare minimum but this also indicates that there had been no selection.

The results of analysis are as follows:-

Table: 1. Number of individuals in different tiers and their inbreeding coefficient

Tier	No. of Individuals	Inbreeding
1	34	0
2	36	0
3	41	0
4	47	0
5	41	0.0152439
6	9	0.007813334

(SC Mehta)

Preparation of breeding plan for the EPC Farm

In order to prepare the breeding plan, a database containing the biometry, body colour, semen quality parameters *etc.* has been prepared for all available breedable animals of the Campus. Looking into the demand of the farmers, the horse needs to be bred for body height and body colour. Accordingly, selection differential for body height and independent culling level for body length and heart girth was adopted for selecting the animals. Specific sire was allotted to a dam for breeding keeping in view of above criteria and the pedigree of the animals to be mated. The semen doses of field stallions available at the Campus were also utilized. The average body height of selected stallions was 158.5±1.26 cm. The breedable mares had average body height 151.76±0.74 cm, body length 151.94±0.68 cm and heart girth 177.94±1.91 cm.

(SC Mehta, RA Legha, RK Dedar, PA Bala, TR Talluri, SK Ravi & Jitendar Singh)

Anti-oxidative properties of donkey milk

Nowadays, it is considered that donkey milk is so similar to human milk that it can fulfill the nutritional requirements

of the infants, high in antioxidant activity as well as it is rich in lactose, lysozyme,-3 and -6 polyunsaturated fatty acids which are similar to human milk. Milk samples were collected from donkeys (Poitou & Indigenous), camel, buffalo and goat from EPC, Bikaner, NRC on Camel, CIRB, Govt. Livestock Farm, Hisar (Fig.1). A comparative assay for total antioxidant activity and ascorbic acid content was done. It has been observed that total antioxidant activity is at its peak in whole milk of indigenous donkey which is followed by whole milk in Poitou donkey. Goat milk shows slightly higher activity than the camel milk and the least amount of TAC activity was observed in milk of Buffalo. Interest to determine TAC in donkey milk is increasing as it is able to give overall picture of antioxidant potential of whole milk. This method is reliable, fast and requires much less infrastructural facility.

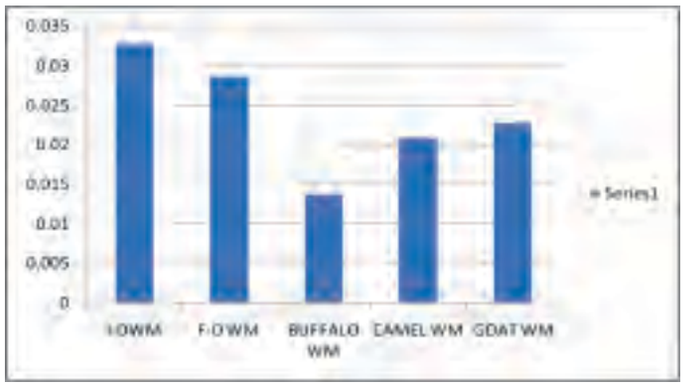


Fig.1: Antioxidant capacity of whole milk (WM) of different livestock

Ascorbic acid estimation in whole milk of different livestock:

Ascorbic acid is also popularly known as vitamin C and it is a very powerful antioxidant. It has well known immune boosting and anti-aging properties. The ascorbic acid concentration was estimated in whole milk of indigenous donkey and whole milk of Poitou donkey, camel, sheep and buffalo(Fig.1). The milk of indigenous donkey has been found to have higher ascorbic acid content as compared to other animals.

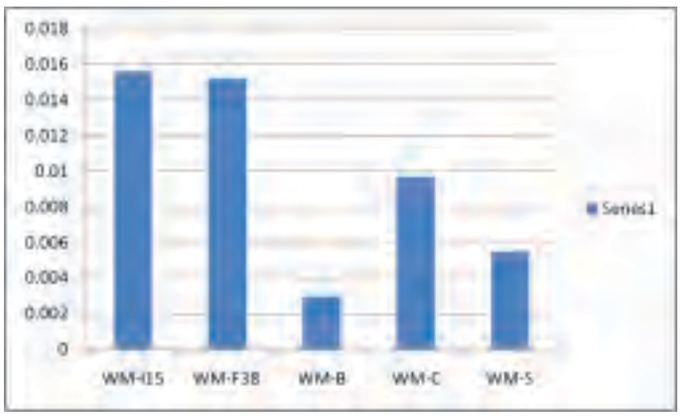


Fig.1: Ascorbic acid content in the whole milk (WM) of different livestock

(Anuradha Bhardwaj, Yash Pal, Varij Nayan, RA Legha, Hema Tripathi & BN Tripathi)

Estimation of pulling capacity and biochemical indices of working Halari donkeys

Pulling capacity of working indigenous donkeys is not known. To measure draft of different pay loads, load cell was put between tractor and cart and regression equation was drawn. Two indigenous donkeys of Halari breed (weight ranged between 210-230 Kg) were selected for the draughtability trials which carried draft equivalent to 15, 20, 25, 30, 35 and 40% of body wt and corresponding draft (Kg) was 33, 44, 55, 66, 77, 88 and corresponding pay load was 815, 900, 982, 1065, 1148 and 1232 Kg, respectively.

Table 1. Bodyweight (%), Draft (Kg) and Payload (Kg)

% Body weight	Draft (kg)	Weight of cart (kg)	Pay load (kg) including weight of operator
15	33	150	815
20	44	150	900
25	55	150	982
30	66	150	1065
35	77	150	1148
40	88	150	1232

Average weight of donkey = 220kg

The pay loads were tested in donkeys using conventional pneumatic two wheel cart on *pucca* road at normal speed of donkeys. Physiological indices, speed, fatigue symptoms (tongue protrusion, frothing, leg un-coordination) were recorded before, during and 20 min after the work as reported by (Bhatt *et al*, 2005) for donkeys. Biochemical profile was estimated before and after work. Body weight loss was recorded. Maximum and minimum temperature (^{0}C) during trials was 37.3±1.93 (35-41) and 21.93±2.03 (18-26). Relative humidity was 32% (10-70%).

In the study, creatinine levels were non-significantly different during different loads in donkeys indicating kidney is working perfectly. Blood urea levels significantly increased during 35 and 40% loads indicating stress to liver during 35 and 40% load. Serum albumin and total protein changed significantly during 40% load only. Cholesterol and cortisol levels were non-significantly different during different loads.

The study showed that Halari donkeys may pull draft of 33Kg for 3 hour, 44, 55, 66 Kg for 2 hour, 77, 88 Kg for 1 hour without much stress to donkeys as fatigue score was less than 7. During the study, it was observed that the fatigue symptoms (tongue protrusion and frothing) were not present in donkeys as heat loss in donkeys is by sweating and not by panting. Changes in physiological responses, reduction in speed, leg incoordination, unwillingness to work and finally to stop working were observed during pulling of 77 and 88 Kg draft. It was observed that Halari donkeys could be used in pulling the load till the animal is tired means when the fatigue score is less than 14. However, for using the donkeys in continuous and regular type work the fatigue score should be less than 7 for keeping the animal healthy and productive.

Development of refined and adjustable saddles and harness for working equines

Various types of saddles are being used for mules, donkeys and horses in Haryana and Rajasthan. Normally iron base of saddle is fitted with wooden piece to fix the saddle properly on back of the animal. To avoid injury the wooden piece is fitted with locally made padding of rag. But most of the time this rag padding is not able to protect the animal from injury or saddle sore due to hardness, unevenness as well as absorbing of sweat. To refine/improvise the existing saddle, wooden piece was covered with leather as shown in picture (A) further, wooden piece was padded with nanda (carpet cloth) in picture (B). Testing of 'B' saddles has been done in institute donkeys for two months. Under saddle, blanket support was provided as shown in picture. The donkeys were comfortable and no injury or saddle mark was observed.

Body confirmation of horse, pony and mule is different. Hence, the saddle made for horse can't be as such used for pony or mule. But most the owner uses the same saddle for mule and pony. Also, the same type of saddle can't be used for donkeys of different sizes. If saddle is not as per the size and shape of back of animal, it may cause injury to the animal. To address this problem, adjustable type saddle was also fabricated.

Fig.1: Donkey under trial with improvised saddles with padding material

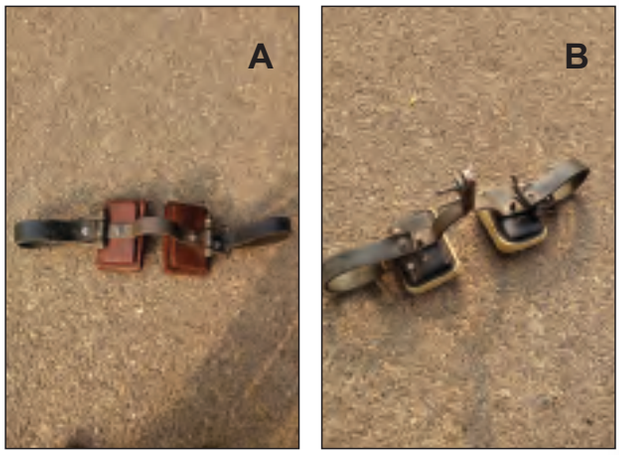


Fig. 2: Improvised carting saddles for donkeys

(RA Legha & Yash Pal)

Protoype of customized Artificial Vagina for semen collection in Stallion

Commercially available artificial vaginas for semen collection of stallions are quite expensive and imported by only authorized firms in India. Here we have developed a prototype of customized artificial vagina for collecting the semen from the stallions using available material in the local market (Fig.1). This AV is being successfully used for routine semen collection at EPC and is proved to be handy and light in weight compared to that of the commercially available AVs.

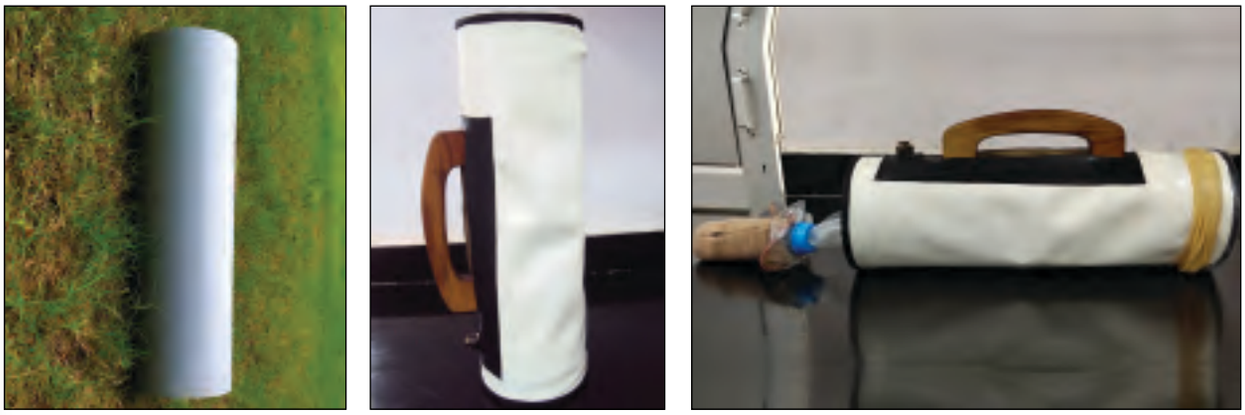


Fig. 1: Prototype of customized AV for stallion semen collection

(TR Talluri, SK Ravi & RA Legha)

Expression of fertility related genes in Marwari stallions

The stallion seminal mRNA was isolated and subjected for analyzing the expression of various fertility related genes like SPATA, PLCz, SP17, PRM1, Ubiquitin and CRISP3 genes. The expression of these genes was correlated with the DNA integrity and acrosome integrity and mitochondrial membrane potential and the studies are in progress. A study was conducted for screening the expression of fertility related genes *viz.*, PLCz, SPATA, PRM, UBIQUITIN and SP17 during breeding and non-breeding season. There was no significant difference was observed in the expression patterns of these genes in both the seasons.

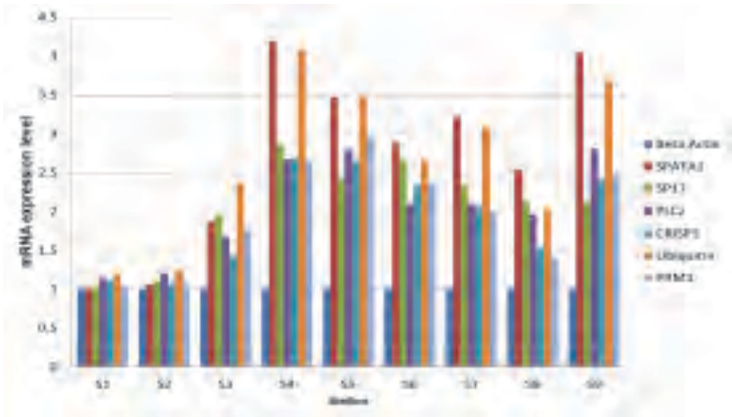


Fig. 1 : Expression of mRNA for different genes in the semen of different Marwari stallions

(TR Talluri, Anuradha Bahradwaj, SC Mehta & Yash Pal)

Bacteriological examination of uterine swabs from infertile mares

For collecting the uterine samples from mares, customized uterine swabs were designed using the sterilized AI (used) catheters (Fig.1). These swabs found to be very much useful in collecting the uterine swabs and flexible as they can be bent. A total of 41 samples from uterus and cervix were collected from the infertile mares from farm as well as field mares and were analysed for the microbial examination. The results from the uterine swabs not revealed any presence of PMN cells but the microbiological examination inferred the presence of *Acinobacter spp.*

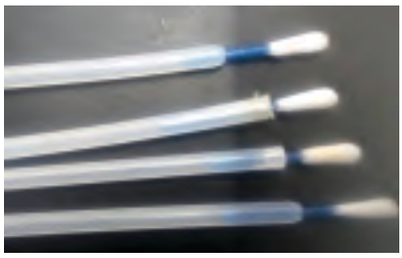


Fig.1 : Customised uterine swabs for uterine sample collection

(TR Talluri, RA Legha, J Singh & RK Vaid)

National Centre for Veterinary Type Cultures

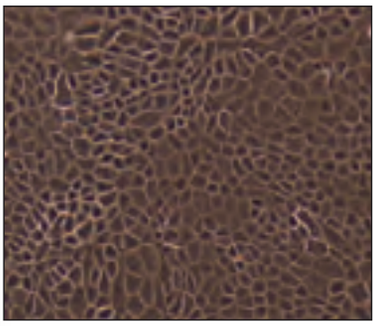
Authentication and accessioning of viruses of animal origin:

NCVTC virus repository is being strengthened with the addition of viruses from different geographical locations of the country through the deposition/collection of isolates and clinical samples from different animals and poultry. During the period 2018-19 a total of 64 virus cultures were processed and out of these 35 were accessioned in the repository to make cumulative virus culture collection to 260 viruses. Further, 114 different biological samples *viz.,* tissue, swabs and blood were collected / received from LUVAS Hisar (37), Nohar, Datta, Kishangarh & Khajuwala, (17), Udaipur (43), Ajmer (8), Mau (3), Bhilwara (4) Rajasthan and Rohtak (2) were also processed for isolation of different viruses. The details of virus authentication/isolation are as follow (Table 1).

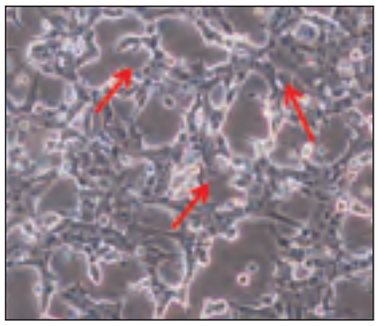
Table 1 : Acquisition / Receipt of viral isolates during 2018-19

Depositor	Name of virus	Number
NCVTC, Hisar	*Peste des petits ruminants* virus	2
	Newcastle disease virus	5
	Fowl adenovirus	12
IVRI , Izatnagar	Newcastle disease virus (R2B, Lasota, NDV-K & NDV-F)	4
	Turkeypox virus	1
	HVT strain of Marek's Disease	1
	Fowlpox virus	1
	Pigeonpox virus	1
	Canine adeno virus	1
	Classical swine fever virus	1
TANUVAS, Chennai	Bluetongue virus	3
	Peste des petits ruminants virus	1
AAU, Khanapara	Newcastle disease virus	6
	Swinepox	2
	Goatpox virus	2
ADMaC Project	Classical swine fever virus	11
	Peste des petits ruminants virus	2
	Fowlpox virus	1
	Pigeonpox virus	1
	Swinepox virus	2
	Goatpox virus	2
	Avipox virus	1
Total		**64**

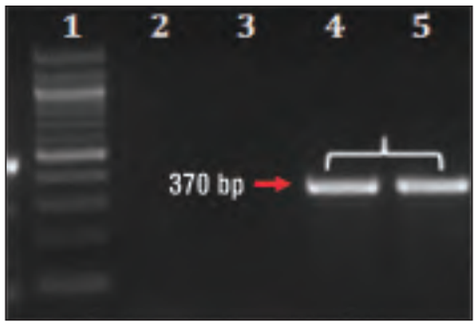
Three bluetongue virus isolates received from TANUVAS were authenticated by amplification of NS1 gene (273 bp) and the viability was confirmed in BHK21 cell line and thereafter accessioned. Furthermore, 10 virus isolates received from AAU, Khanapara including 6 NDV isolates were authenticated by amplification of F gene (356 bp). Viability of 5 NDV isolates was confirmed by virus isolation in SPF eggs and the isolates were accessioned, while replacement was sought for the remaining isolates. Eight vaccine virus isolates deposited by IVRI were also confirmed by amplification of specific virulence genes including four NDV isolates authenticated by amplification of fusion gene (356 bp). Pigeonpox, Turkeypox and Fowlpox isolates were authenticated by amplification of DNA polymerase gene (573bp), however their viability could not be confirmed in CEF and SPF eggs, so replacement has been sought. A canine adenovirus isolate was authenticated by amplification of hexon gene and the viability could be confirmed in MDCK cells upon 3rd passage (Fig. 1).



MDCK control cells



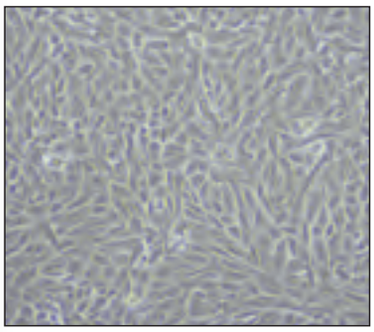
MDCK infected cells



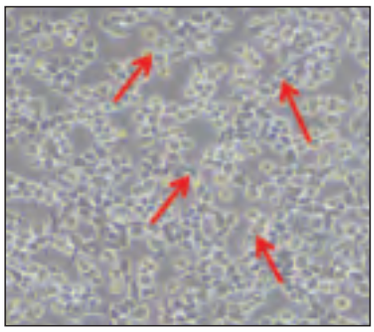
Hexon gene amplification of CAdV : 1: Ladder 100 bp; 2: NTC; 3: negative control; 4: positive control; 5: Sample

Fig.1 : Authentication & Isolation of Canine adeno virus

Five Newcastle disease viruses were isolated from tissue samples collected from a poultry farm at Ajmer Rajasthan. The isolation was carried out in 10 days old SPF eggs by allantoic route of inoculation. Characterization of these isolates was also done by RFLP and sequence analysis (Fusion gene) which indicated mesogenic strains. A suspected BHV-1 infection in an organized cattle farm at Bhilwara was also confirmed by PCR amplification of *glycoprotein B* gene. The virus could also be isolated in MDBK cells upon 4th passage (Fig. 2).



Vero control cells

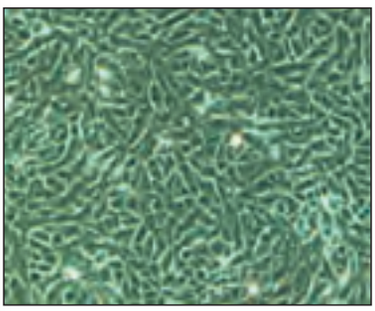


BHV-I infected vero cells

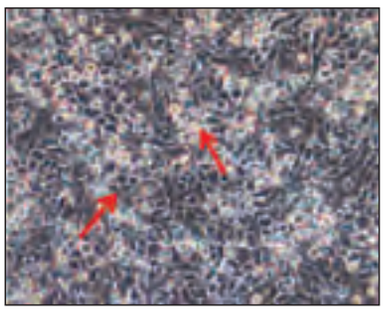
Glycoprotein B gene amplification : 1: Ladder 100 bp; 2: NTC; 3: negative control; 4: positive control; 5: sample

Fig. 2 : Authentication & isolation of BoHV-1

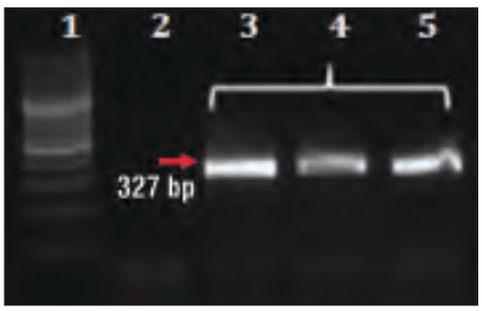
Two PPR outbreaks at Nohar and Khajuwala (Rajasthan) were also confirmed by amplification of N gene (327 bp) of PPRV and the virus was isolated in Vero cells upon 4th passage (Fig 3).



Vero control cells



PPRV infected cells



Nucleoportein gene amplification of PPRV: 1: Ladder 100 bp: 2: Negative control; 3: Postiver control: 4 and 5: samples

Fig. 3 : Authentication & isolation of PPRV

Over all a total of 35 viruses were authenticated, accessioned and cryo-preserved in the repository (Table 2). Besides, 31 previously preserved viruses including Bovine rotavirus (3), Bluetongue virus (2), Infectious bursal disease virus (4), Newcastle disease virus (16), Fowlpox virus (2) and Duckplague virus (4) were revived and checked for their viability and all these viruses were found viable.

Table 2 : List of viruses accessioned in the year 2018-19

Name of virus	Number
Peste des petits ruminants virus	2
Bovine herpes virus-1	1
New castle disease virus	14
Fowl adenovirus	12
Canine adenovirus	1
Classical swine fever virus	1
Bluetongue virus	3
Fowlpox virus	1
Total	**35**

(Sanjay Barua, Naveen Kumar & Riyesh T)

Complete genome analysis of chicken astroviruses isolated from poultry

Astroviruses (family Astroviridae) are small, non-enveloped, positive sense, single-stranded RNA viruses associated with gastro-enteritis in humans and enteritis, nephritis/hepatitis and growth depression in animals and birds. Astrovirus infections in poultry are becoming a growing concern in veterinary and public health which leads to severe economic losses to poultry industry and affecting food production worldwide. Currently, at least six genetically distinct astroviruses have been identified in poultry and among these turkey astroviruses (TAstV) and avian nephritis virus (ANV) have been well studied. Although chicken astroviruses (CAstV) have been found to be associated with enteritis and gout/nephritis in chicken, little is known about the genetic diversity and ecology of CAstV. In this regard, in order to examine the genetic diversity of CAstV, complete genome sequencing of two CAstV (isolated in NCVTC repository from Haryana) was carried out employing 10 sets of overlapping primers. The genome analysis revealed that the complete genome is of 7.5 kb in length and both the isolates were closely related to an isolate previously reported from India (CAstV/INDIA/ANAND/2016).These isolates have a nucleotide identity ranging from 97.1 to 97.3% with CAstV reported from Anand, Gujarat and 86.1 to 92.0% with CAstV isolates reported from other countries (Fig.1).The high sequence similarity of the present isolates with CAstV previously reported from the country indicates the limited sequence divergence of CAstV in the country. Hence, development of a vaccine using a CAstV strain currently circulating in the country may give protection to birds against CAstV infection and both these isolates (genetically characterized) have the potential to be developed as candidate vaccine virus. Despite all these, the recent identification of a highly divergent CAstV from an enteritis case (our un published data) warrants investigation in ascertaining the circulation of two strains of CAstV (one causing enteritis and the other causing both enteritis and nephritis/gout) in the country.

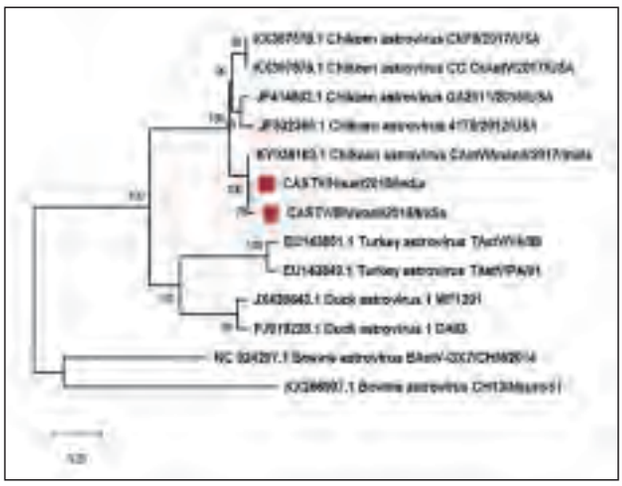


Fig. 1 : Phylogenetic analysis of chicken astroviruses The evolutionary history was inferred using the Neighbor-Joining method. The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (500 replicates) are shown next to the branches . The tree is drawn to scale, with branch lengths in the same units as those of the evolutionary distances used to infer the phylogenetic tree. The evolutionary distances were computed using the Maximum Composite Likelihood method and are in the units of the number of base substitutions per site.

(Riyesh T, Naveen Kumar, Sanjay Barua & BN Tripathi)

Prevalence studies for porcine respiratory viruses and development of their repository

A. Porcine cirovirus infection associated with reproductive failure in sow and neonatal piglet mortality

Porcine circovirus (PCV) is one of the important swine viruses causing a diverse range of diseases which incur huge economic losses in swine industry globally. The PCV is a small non-enveloped circular single-stranded DNA virus under the genus Circovirus within the family Circoviridae. Till now, PCV2 is the only member of this genus causing diseases in pigs termed as PCV- associated diseases (PCVD) worldwide including in India. Recently, a novel PCV type 3 (PCV3) was first reported from USA in 2015 from pigs with cardiac and multisystemic inflammation syndrome. PCV3 has been detected from affected sows with porcine dermatitis, nephropathy syndrome and reproductive failures. The clinical cases of PCV3 infection have been described from Europe, China, South Korea and Japan. In the present study, we investigated the cause of the incidences of reproductive failure in sows and neonatal piglet mortality in a farm located at Chhattisgarh, India. The problems in breeding sows were characterized by abortions, stillbirth and repeat breeding; while the new born piglets were showing swollen legs, facial oedema and mortality within first week of life (40%). The surviving piglets exhibited clinical signs of fever, nasal discharge, coughing, dermatitis, cachexia and death within 6 months of age. The presence of other common porcine viruses such as porcine reproductive and respiratory syndrome virus (PRRSV), PCV2, porcine pseudorabies virus (PRV), classical swine fever virus (CSFV) and swine influenza were not detected in clinical samples. The PCV3 was detected in tissue samples (lung, heart, liver, kidney, spleen and naval cord) collected from stillborn piglet by PCR amplification of 425bp region of cap gene (Fig.1) and sequences of the amplicons showed 100% similarity with the available PCV3 genome sequences.

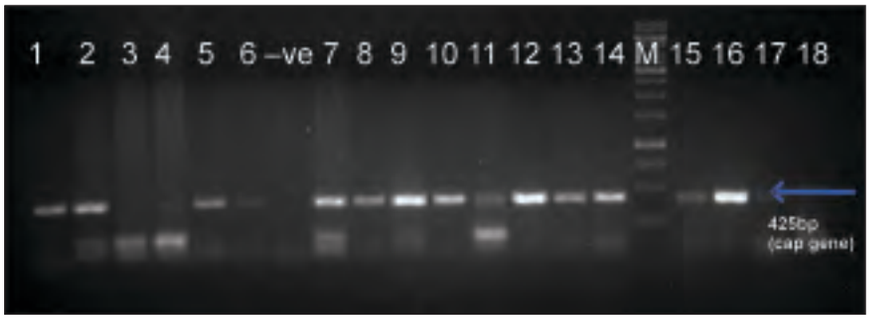


Fig. 1 : PCR amplification of PCV3-specific cap gene (425bp) in tissues collected from stillborn piglet.

Subsequent to the identification of PCV3 in still born piglets from Chhattisgarh, the positive amplification of PCV3-specific nucleic acids was also found in tissues and serum samples collected from apparently healthy house hold pigs from Mumbai (abattoir), Guwahati and Mizoram with unknown history. We also observed co-circulation of different viruses viz., PCV2 +PCV3 (6 nos), PCV2 +PCMV (17nos) & PCV2 + PCMV + PRV (2nos) in apparently healthy pigs. The results of the present study indicate the co-circulation of porcine ciroviruses along with other respiratory viruses in Indian pig population in association with clinical cases and also in apparently healthy pigs. This emphasizes the need of thorough investigation on the presence of porcine circoviruses for deciphering the epidemiology, pathogenesis and also to implement the control measures which may cause serious health hazards to pigs.

B. Genetic characterization of porcine circovirus 2 & 3 (PCV2 & PCV3)

The complete genome of PCV3 were amplified directly from four tissue homogenates and sequencing results showed that genome is of 2000 nucleotide length. The BLASTn homology analysis confirmed the PCV3 genomes showing 97-99.8% identity with the PCV3 sequences available in the public database. The Indian PCV3 strains have shared 99.8% similarity at genome level. The PCV3 encodes three ORF (Open reading frame):ORF1- rep gene, ORF2- cap gene and ORF3- hypothetical protein coding geneas described previously. The ORF1 encoding for replication – associated protein was identified from 216 to 1104 nt position. The coding region of ORF2 in India strains was identified from 1336 to 1980nt position in revere orientation to the ORF1 sequence. The predicted Rep protein sequences shared 100% identity among Indian strains, whereas 99.3 to 100% similarity observed with other PCV3 strains circulating worldwide. The predicted cap protein of Indian strain showed 98.6% similarity among themselves and revealed identity from 97.67% to 100% with other available sequences in database. A point mutation

(Asn56Asp) was observed in cap protein in Indian strains along with strains from USA (PCV3/USA/MN/2016) and China (PCV3/China/YN3/1996) in comparison to rest of the compared strains.This indicates that further analysis of the aa substitution is needed for elucidation of functional role in the antigenicity of the virus.The phylogenetic analysis was carried out to investigate the evolutionary relationship of Indian PCV3 strains with reported circulating strains from different countries. The genome-based phylogeny revealed that Indian PCV3 strains were grouped with the PCV3 strains from China, South Korea, USA, Germany and Russia (Fig. 1).

The whole genomes of PCV2 were amplified directly from the tissue, sera and nasal swabs collected from Chhattisgarh, Maharashtra and Guwahati. The sequence data showed that the genomes of PCV2 contain 1767 nucleotides. The BLASTn homology analysis revealed 95.7 to 99.8% identity of Indian strains with the available PCV2 sequences in database. The PCV2 genome encodes three major ORFs: ORF1- encodes replicase (Rep) proteins involved in virus replication; ORF2 - encodes the viral capsid (Cap) protein and ORF3 - encodes a protein involved in PCV2-induced apoptosis in vitro. The Indian PCV2 sequences showed ~99.8% similarity with isolates from China, USA & Germany. The cap proten is the main structural protein which is responsible for main immunogenic antigen of virus. This protein is relatively conserved, but we observed some mutations in Indian isolates, which suggests the need for further functional analysis of these mutations in relation to disease pathogenesis is required as mutations in this protein lead to failure in nutralizing antibodies. The evolutionary analysis through phylogeny revealed that Indian PCV2 grouped under the PCV2-2d class and showed clustering closely with isolates from China, USA and Germany (Fig. 2).

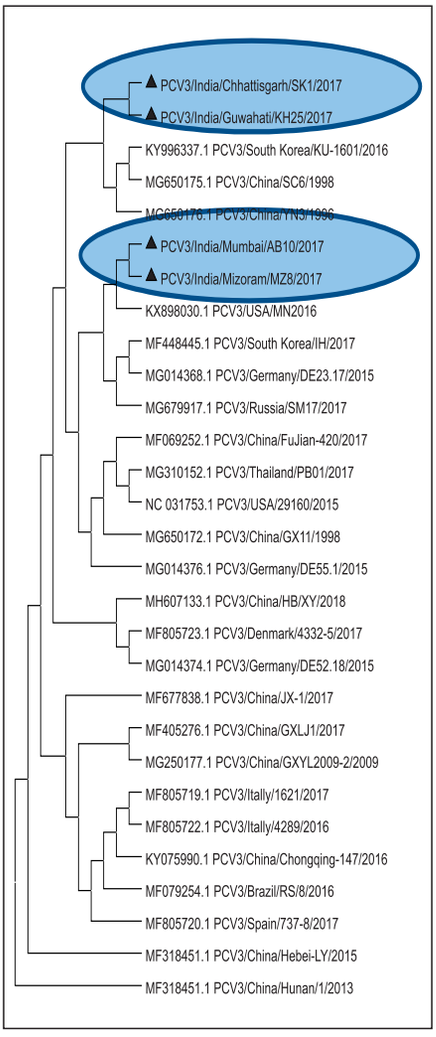


Fig. 1 : Phylogenetic analysis of porcine circovirus 3 genome sequences.

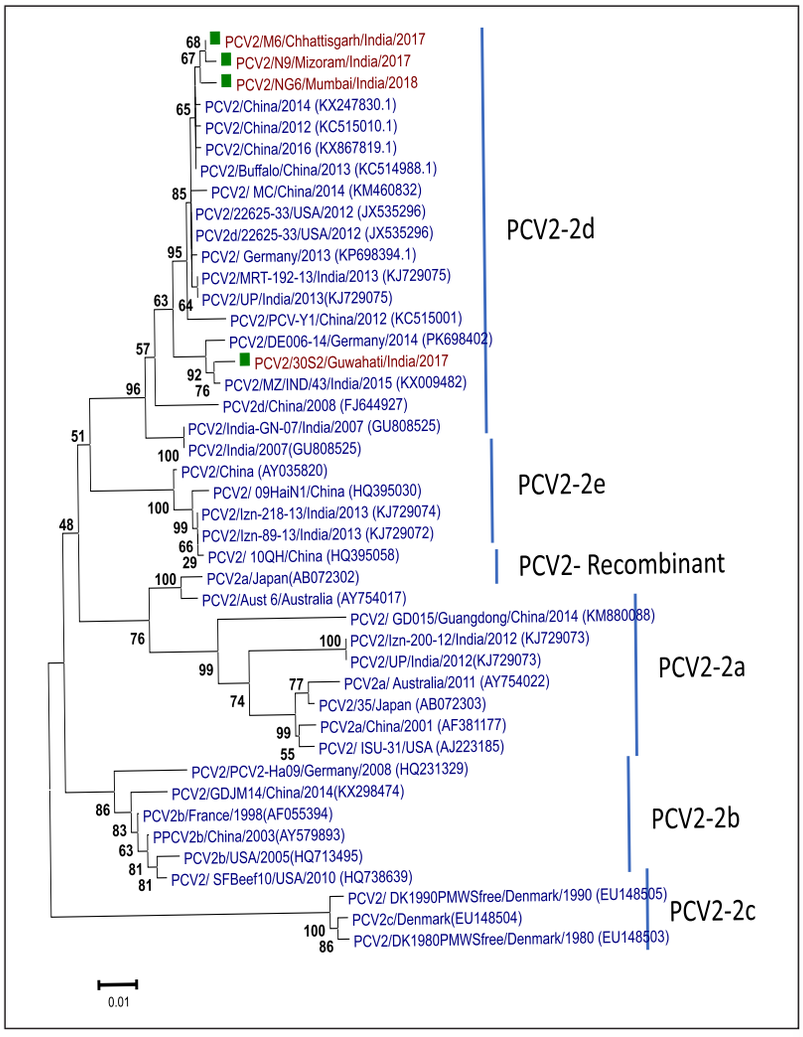


Fig. 2 : Phylogenetic analysis of porcine circovirus 2 genome sequences.

C. Developed repository of accessioned recombinant clones as genetic resource of microbial pathogens: The repository of accessioned recombinant clones of genes/genome of pathogens is being strengthened for conservation of microbial genetic resources. The clone library has been further strengthened with the addition of accessioned recombinant clones (16nos) of genomes of PCV2 (4 nos) and different segments of PCV3 genomes (no=12). All clones were generated by cloning of the amplicons into pTZ57R/T vector, sequenced and verified by BLAST, NCBI homology analysis of the sequence data.These state-of- the-art genetic resources will serve as reference material as well as for specific application in future R&D.

(BC Bera, Taruna Anand, Nitin Virmani & Sanjay Barua)

Accessioning of bacterial cultures in NCVTC

During the period 2018-19 a total of 272 bacterial cultures were processed and out of these 123 were accessioned in the repository to make cumulative bacterial culture collection to 1394 veterinary bacteria. Cultures were submitted from CIRG, Makhdoom; CMVL, Meerut; Tamilnadu Veterinary & Animal Sciences University, Chennai; IVRI, Izatnagar; College of Veterinary Sciences, AAU, Khanapara; CSKHPKV Palampur HP; MQTS Lab. Jaipur; SKUAST Jammu; NIBSM, Raipur and NRCC, Bikaner and collected & isolated by bacteriology laboratory, NCVTC, NRCE, Hisar. In addition, 101 Cultures are ready to be accessioned. In addition, 237 pathological/other samples received/collected from J&K, Rajasthan, Haryana, Punjab, Uttarakhand and Maharashtra consisting of samples from goat/sheep (27); cattle/buffalo (3); farm water (7); poultry (16), equines (118), dog (27), pig (10), milk samples (22), stallion semen (6) and human (1) were processed leading to isolation of 401 cultures, which are preserved in general preservation. The important bacteria isolated are *Vibrio parahemolyticus* and *Streptococcus agalactiae* from cattle milk, *Fusobacterium* spp. from foal-joint fluid, *Streptococcus zooepdemicus* from uterine swab of aborted mare (Fig. 1 a - d). Some of the other strains accessioned are shown (Table 1).

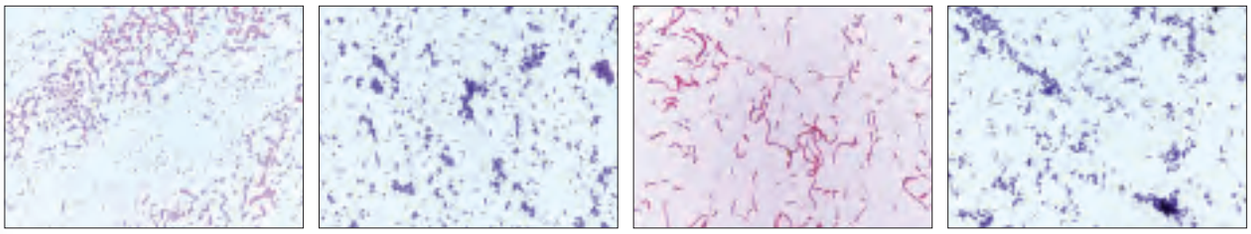


Fig. 1 : a). Gram negative rods of *Vibrio parahemolyticus*; b) small Gram positive cocci of *Streptococcus agalactiae*; c) Filamentous *Fusobacterium* spp., d). Gram positive cocci of *Streptococcus zooepdemicus* .

Table 1 : Some of the bacteria isolated and accessioned in repository

Aeromonas hydrophila	*Aeromonas veronii*	*Aeromonas sobria*
Aeromonas caviae	*Aeromonaas puntata*	*Aerococcus viridans*
Acinetobacter johnsonii	*Acinetobacter baumanii*	*Arthrobacter creatinolyticus*
Fusobacterium spp.	*Bacillus pichintoyi*	*Bacillus firmus*
Bacilus pumilus	*Clostridium perfringens*	*Comamonas testeronii*
Citrobacter werkmanii	*Clsotridium sporogenes*	*Plesiomonas shigelloides*
Enterobacter cloacae	*Enterococcus fecium*	*Enterococcus faecalis*
Streptococcus gallolyticus	*Streptococcus agalactiae*	*Enterococcus avium*
Pseudomonas anguilliseptica	*Pseudomonas putida*	*Klebsiella oxytoca*
Salmonella Typhimurium	*Lactococcus lactis*	*Microbacterium aurum*
Vibrio parahemolyticus	*Pseudomonas cuatrocienegasensis*	*Pseudomonas stutzeri*
Pasteurella multocida	*Micrococcus lyae*	*Staphylococcus aureus*
Streptococcus zooepidemicus	*Streptococcus equi*	*Ralstonia picketii*

In addition to aerobic bacteria, 29 anaerobic bacterial isolates from soil, poultry and horse dung samples were identified and preserved. The important anaerobic isolates include *Clostridium sporogenes* (n=3); *Paraclostridium benzoelyticum* (n=3);4 strains of *Clostridium perfringens* (Eq151C, Eq151H, Eq190, Eq188). MALDi-TOF analysis was also carried out on some of the anaerobic cultures *viz.,Clostridium sporogenes* and *Clostridium perfringens cultures.* The accessioned anaerobic cultures of *Clostridium* spp are now available for distribution for research and teaching purpose.

Salmonella Gallinarum ERIC-PCR:

Enterobacterial Repetitive Intergenic Consensus-Polymerase chain reaction **(**ERIC-PCR) was conducted on 41 *Salmonella* Gallinarum isolates for molecular typing. All the 42 isolates were grouped into eight clusters at 80% similarity using PyElph 1.4 software with discriminative power of 0.725. Higher value of Discriminative power (Close to 1.00) reflects higher discriminative potential of the test. Largest cluster was cluster VII with maximum number of 20 isolates, whereas Cluster IV and VIII have single isolate only (Fig. 2).

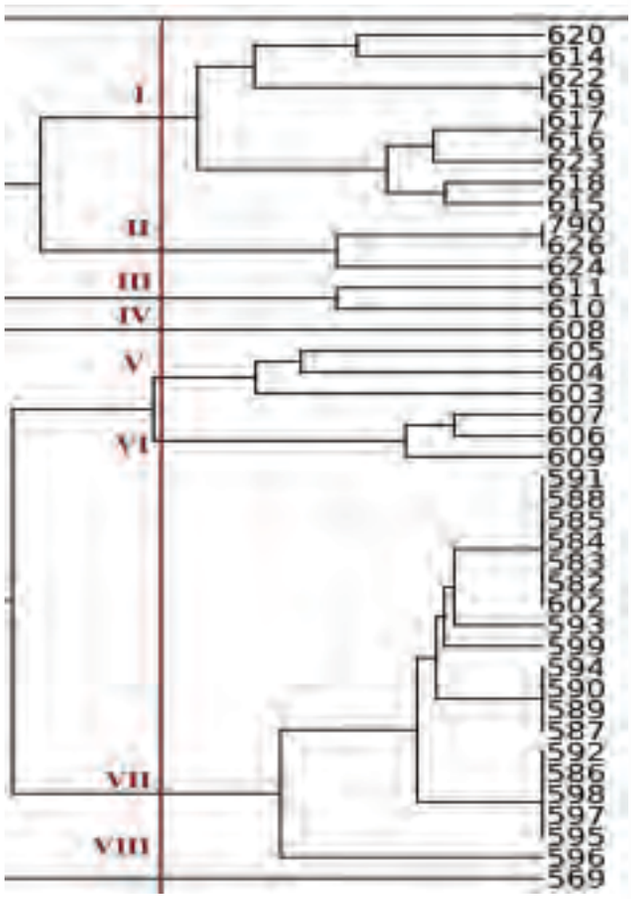


Fig. 2 : Dendrogram clustering the 41 field strains of *Salmonella* Gallinarum strains through UPGMA method and Dice similarity coefficient

(RK Vaid, Taruna Anand, K Shanmugasundaram, Riyesh T & BC Bera)

Indian network for fisheries and animal antimicrobial resistance (INFAAR) Network Project

In order to perform surveillance of antimicrobial resistance (AMR) against bacterial prevalence among Indian livestock species, ICAR has embarked upon an ambitious network project comprising of ICAR Institutes and universities in which *Staphylococcus aureus* and *Escherichia coli* isolates from cattle, sheep, goat, pigs and poultry will be tested for carriage of various AMR factors. In this project, milk samples from cattle, cloacal swabs from chicken, and rectal swabs from sheep and pigs were collected from Hisar Block. From cattle milk samples, *S. aureus (n=12)* were isolated and further confirmed phenotypically and by nuclease gene based PCR. From chicken five *E. coli and* one each of *Staphylococcus intermedius* and *Staphylococcus xylosus* were isolated. From sheep and pig *E. coli* (n=9) and *Staphylococcus* spp (n=3) were isolated.

The *E. coli* (15) isolates were tested against oxymino-cephalosporins and monobactams. All the isolates of *E. coli* showed zone of inhibition indicating ESBL production

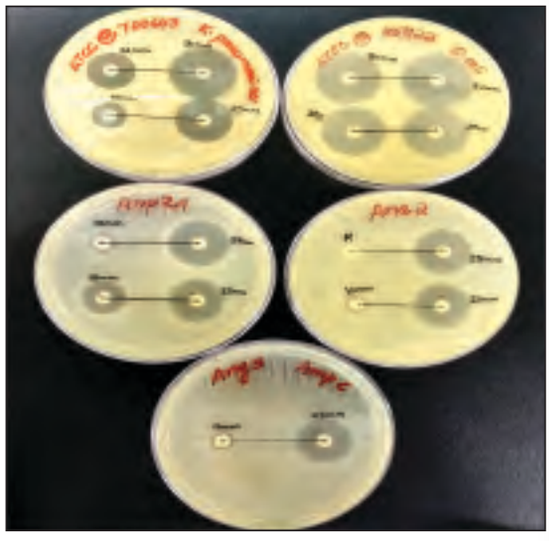


Fig.1: Two *Escherichia coli* Anp2A from pig & Ana2 from poultry strains confirmed for ESBL production by combined disc method. Amp C detection by double disc synergy test showing 1 goat isolate of *E. coli* (Ang 3) positive.

capability using cephalosporins, however, two *E. coli* (Anp2A-pig & Ana2-poultry) isolates were confirmed by combined disc method for ESBL production. Anp2A and Anp3 strains of *E. coli* isolated from pigs were found to be Multi drug resistant (MDR) with resistance against 5 classes of antimicrobials. For ampC detection, double disc synergy test using cefoxitin-cloxacillin combination was done for 4 cefoxitin-resistant suspected *E. coli* isolates, out of which 1 (Ang3-goat isolate) was ampC confirmed (Fig. 1). These *E. coli* porcine and poultry strains were also confirmed positive by multiplex PCR for positive for TEM-1 & 2 (800 bp product) (Fig. 2) and *amp*C (634 bp). Among *S. aureus* strains, none were found to be positive for methicillin resistance by *mec*A PCR. One Ana1D strain of *Staphylococcus xylosus* from poultry was detected multidrug resistant showing resistance to erythromycin, penicillin, tetracyclines, sulphonamides and linezolid. The results show ESBL resistance among *E. coli* isolates from sheep, goat and poultry.

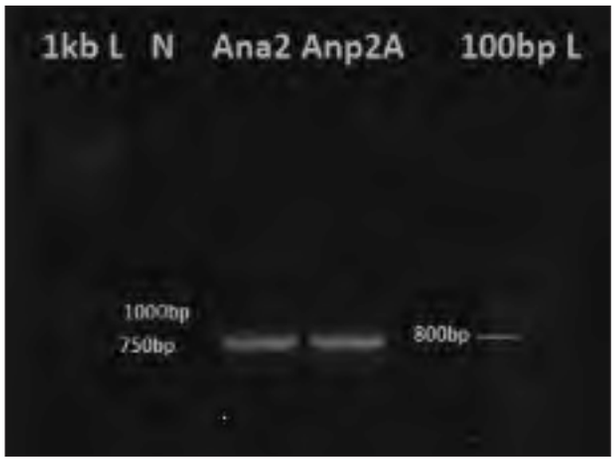


Fig. 2 : Tem-1 & Tem-2 positive (800 bp) in pig and poultry E. coli isolate

(RK Vaid, Taruna Anand & Harisankar Singha)

Isolation, characterization and generation of repository of mycobacterial species

A total of 43 milk samples from local retail milk outlet and organized farms and 23 lung samples from pigs, 64 faecal samples and 10 intestinal samples from cattle, sheep and goatswere also collected for mycobacterial isolation. Microscopical examination of fecal and Intestinal samples for acid-fast bacteria revealed the presence of acid fast bacterium (AFB) (Fig. 1).All these biological sampled were processed for isolation and are under incubation. Three PCRs (using different set of primers *afb, hsp* and *IS900*) were also standardized identification mycobacterial species using reference isolates (Fig. 2). The PCR on genomic DNAs extracted from milk, blood, lung and fecal (cow) samples revealed that all the samples are negative for *Mycobacteria* spp.

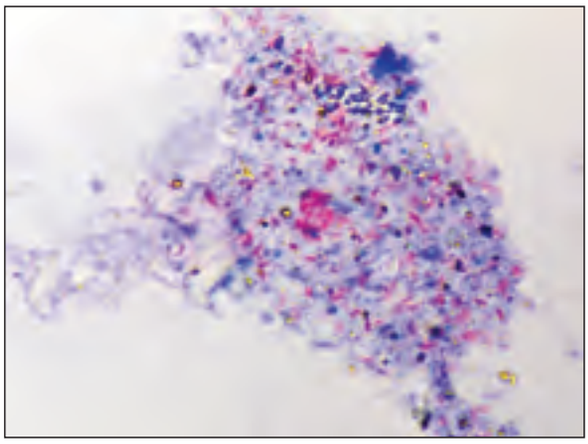


Fig.1 : Acid fast staining of sheep intestinal tissues reveals the presence of *Mycobacterium avium* subspecies *paratuberculosis*.

PCR amplification fecal samples (MAP/*S900*) **PCR amplification milk samples hsp**

Negative for MAP **Negative for *Mycobacterium* spp.**

Fig. 2 : PCR amplification of *Mycobacterium* species targeting different mycobacterial specific genes.

(K Shanmugasundaram, RK Vaid, BC Bera & BN Tripathi)

Bacteriophages against *Staphylococcus spp*. show synergy with antibiotics

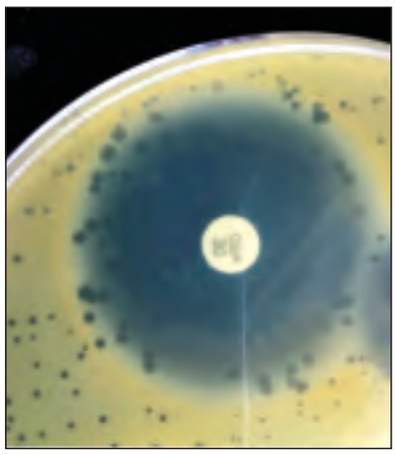


Fig.1 : Increased plaque size in the zone of sub-optimal concentration of antibiotic CEP

Many classes of antibiotics at sub-lethal concentrations tend to increase the biomass and hence the biosynthetic capacity of bacterial cells. The virulent phages take advantage of this altered cellular state and increase their own production leading to phage antibiotic synergy (PAS), which can be used as a means to overcome emerging antibiotic resistance by using suboptimal concentration of antibiotics in combination with specific bacteriophages. An increase in the plaques size in the zone of suboptimal antibiotic concentration serves as an indicator of PAS effect. It is important to note that all phages do not show this PAS effect and many phages show this PAS effect with specific antibiotics only. In our study, we tried to explore PAS effect with different antibiotics using 14 numbers of bacteriophages isolated against mastitis causing bacteria. We could observe that many of these phages showed PAS effect in presence of different classes of antibiotics against mastitis causing pathogens – mainly *Staphylococci*. The PAS effect was observed with CEP alone (2nos.); Penicillin and CEP (2nos.); CEP, OF and CEC (3 nos.); and CEP and TR (1no.) overall totalling to 57% (8/14nos.) of phages. The plaque size (measured microscopically) in the suboptimal zone of antibiotics was significantly increased, which was used as an indicator to assess the PAS effect (Fig.1). The synergistic effect of bacteriophages and antibiotics may provide a better alternative to kill virulent bacteria than either treatment given individually in mastitic bovines.

(Taruna Anand, RK Vaid, Nitin Virmani & BC Bera)

Characterization of bacteriophages against *Klebsiella pneumonia* isolated from mastitic milk

A bacteriophage VTCCBPA119 was isolated against host FOP235, identified as *Klebsiella pneumoniae*. The bacterium was isolated from mastitic milk and was identified by 16s rDNA sequencing technique. The bacteriophage was enriched from farmyard soil and a single plaque was purified three times by agar-overlay technique. The size of the plaque was found to increase with time upto seven days (0.5 cm-2.6 cm) of incubation at 37°C on nutrient agar after that no further increase in size observed. VTCCBPA119 was found to be temperature tolerant in the range of 4°C to 55°C and within a narrow pH range of 6-9. The biological activity assessment of the phage showed it to be in narrow range spectrum where it was found to be strongly lytic against only two (2/10) of *K. pneumonia* tested. Another phage –VTCCBPA118 which produced plaques of 2mm size with a zone of halo was also isolated against *K. pneumonia* and it's shelf life was assessed at 37°C for a period of 90 days. VTCCBPA118 was observed to be viable upto 90 days with a slight decrease in the phage titre (Table 1) *vis-a-vis* the no. of days of incubation at 37°C. The assessment of shelf life at 37°C is an important factor to determine the phage stability where cold chain availability is limiting.

Table 1: Shelf life of bacteriophage VTCCBPA118 at 37°C

No. of Days	Spot test	Titre
1	+	$2.3X10^{18}$
4	+	$2.3X10^{18}$
11	+	$1.9X10^{18}$
20	+	$1.9X10^{18}$
30	+	$3.1X10^{17}$
50	+	$1.7X10^{17}$
60	+	$2.4X10^{16}$
90	+	$2.0X10^{16}$

(Taruna Anand, RK Vaid, Nitin Virmani & BC Bera)

Laboratory induced development of phage resistant mutant

Bacteria can resist phage attack through different mechanisms, including: spontaneous mutations, restriction modification systems, and adaptive immunity via the CRISPR-Cas system. This issue was addressed in a small study where a new phage against a laboratory induced resistant mutant was obtained. The resistant mutant of *Staphylococcus spp*. named as *RM Fop 171A* was first generated by long incubation of the host bacteria with it's correspondingly active phage under continuous shaking conditions for 9-10 days at 37°C. The confirmation of resistant mutant was done by biological activity assessment using spot test using a panel of 14 nos. of different bacteriophages (Table 1). Further the developed resistant mutant of *Staphylococcus spp. (RM Fop 171A*) was used to enrich the corresponding bacteriophage from the sewage. The experiment provided evidence that resistant mutants can be generated in laboratory and it is feasible to isolate bacteriophages against resistant mutants from environmental sources.

(Taruna Anand, RK Vaid, Nitin Virmani & BC Bera)

Table 1: Assessment of biological activity by spot test

Phage	Fop 171A	RMFop 171A
BPA 106	+	-
BPA 107	-	-
BPA 108	-	+
BPA 109	-	+
BPA 110	-	-
BPA 111	-	-
BPA 112	+	+
BPA 113	+	-
BPA 114	-	+
BPA 115	+	+
BPA 116	+	+
BPA 117	-	-
BPA 118	-	-
BPA 119	-	-

Isolation of ESBL *E.coli* and highly resistant *Salmonella spp.* from poultry farm samples

The extended spectrum beta-lactamase (ESBL) producing *E. coli* are emerging world-wide and because of their high antibiotic resistance they affect the course and outcomes of infections both in the community and hospital settings. The ESBL *E.coli* is highly prevalent in poultry too and the chicken meat has been implicated as a source of ESBL producing *E.coli* in the human population. Also the emergence of antibiotic resistant *Salmonellae* is an important issue with regard to poultry. With the aim of isolation of bacteriophages against ESBL producing *E. Coli* and *Salmonella spp*. the different samples *viz.,* cloacal swabs (15 nos.), poultry litter (9 nos.) and poultry farm soil (1no.) were collected from two different poultry farms. The bacteria were purified on ESBL agar and Salmonella agar to specifically enrich the targeted bacteria (Fig.1). Three bacteriophages against *E.coli* (VTCCBPA133, 135, 136) and one against *Salmonella spp*. (VTCCBPA134) were isolated and purified from poultry litter (Fig.2).

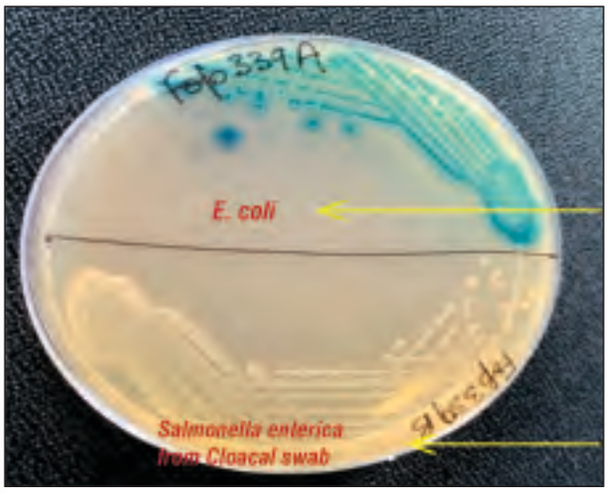


Fig.1 : Isolation of ESBL *E.coli* and *Salmonella* spp. from cloacal swabs

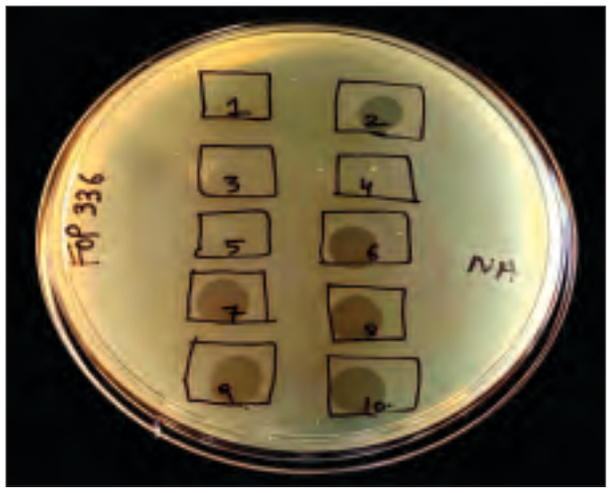


Fig.2 : Spot test of phage isolates purified from poultry litter

(Taruna Anand, RK Vaid, Nitin Virmani & BC Bera)

Generation of CBX5 knockout cells by CRISPR/Cas9-mediated genome editing

Advances in genomic technologies and RNA interference (RNAi) methodologies has allowed for the development of high-throughput genome-scale RNAi screens for cellular factors which, when depleted have an impact on infections. This systems approach has enormous potential for the discovery of both new therapeutic targets, and a better understanding of virus-host interactions. Viruses are obligate intracellular parasites and heavily dependent on host cell machinery to replicate. Genome-wide siRNA screens for herpes simplex virus type 1 (HSV-1) have also identified several host genes with proviral (~200 genes) or antiviral (~100 genes) functions. Nuclear receptor subfamily 3, group C member 2 (NR3C2), glucokinase regulator (GCKR), chromobox homolog 5 (CBX5), homeobox A10 (HOXA10), glycoprotein V (GP5), proteosome 26S subunit, non-ATPAse, 5 (PSMD5), mediator complex subunit 23 (Med23), lysyl oxidase (LOX), CD 53 were the key antiviral proteins identified. Since siRNA knockdown of these individual host proteins results in enhanced (above normal) HSV-1 production, development of knockout cells would be helpful to scale-up viral vaccine production. Simultaneous disruption of multiple antiviral proteins is likely to further enhance virus production.

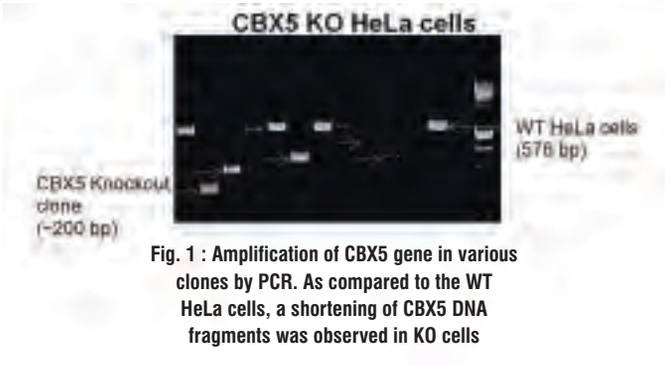


Fig. 1 : Amplification of CBX5 gene in various clones by PCR. As compared to the WT HeLa cells, a shortening of CBX5 DNA fragments was observed in KO cells

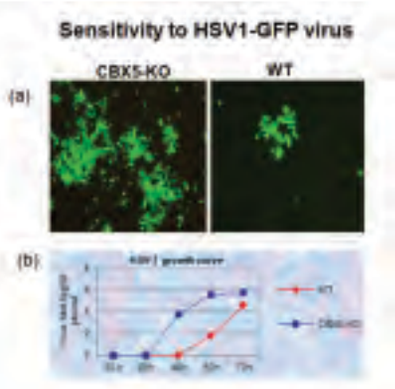


Fig. 2 : Sensitivity of WT and CBX5 KO HeLa cells towards HSV-1GFP replication : (a) Fluoresence (b) Virus titres measured in the supernatant of the virus infected cells at various times post-infection.

We exploited CRISPR (clustered regularly interspaced short palindromic repeats)/Cas9 technology to develop knock out HeLa cells deficient in antiviral (anti-HSV1) cellular protein CBX-5. The CBX5 knockout cells were successfully developed and validated. Amplification of CBX5 gene by PCR showed a deletion of ~300 bp in CBX5-KO cells (Fig. 1) which was also confirmed by nucleotide sequencing. The CBX5-KO cell lines showed more sensitivity for herpes simplex virus type 1 (HSV-1) replication (Fig. 2).

This is first proof of concept study to generate genetically engineered cells lines by CRISPR/Cas9-mediated genome editing to scale up virus production in cultured cells. To further enhance virus production (vaccine manufacturing), we have knocked out additional host genes with antiviral functions *viz; HOXA10, Med23, NR3C2*. The multiple knockout cells (double/triple) are under validation and characterization for their sensitivity to HSV-1. The technology is likely to be cost effective to scale up virus production for vaccine manufacturing. It can be applied to scale up vaccine production, particularly veterinary viral vaccines such as FMD and PPR where limited capacity of the manufacturers cannot meet the demand of various stakeholders in the country.

(Naveen Kumar, Riyesh T, Balvinder Kumar, Sanjay Barua & BN Tripathi)

Research achievements of rumen microbes component

Good progress has been made in the reposition of rumen microbes. In the current year, 49 rumen bacteria were added to the repository. At present the overall strength of repository is 454 which comprise of 339 anaerobic bacteria, 107 anaerobic fungi and 8 methanogenic archea representing 54 genus of gut/ faecal microbes, 4 genus of anaerobic fungi and 4 genus of methanogenic archea (Fig.1 & 2). Study on metagenomics of an assemblage of microorganisms in crossbred cow fed paddy straw was also conducted this year. Genus level taxonomic hit distribution showed that 18.5% sequences belonged to Prevotella, 12.9% sequences belonged to Porphyromonas and 7.3% sequences belonged to the genus Coptotermes.

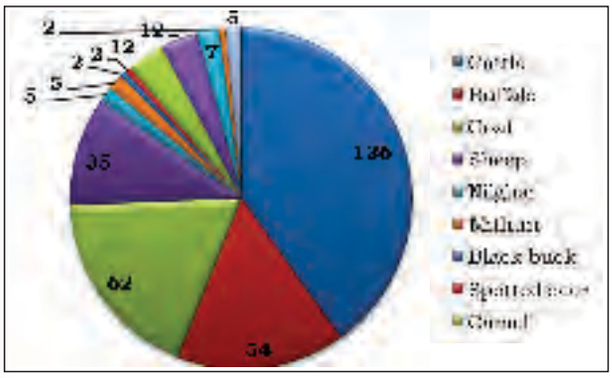


Fig. 1 : Number of gut bacterial isolate and its animal source

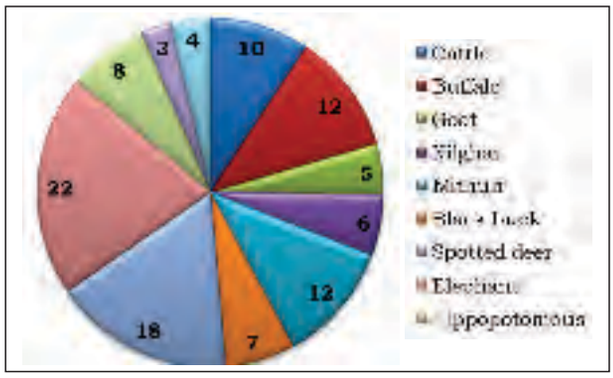


Fig. 2 : Number of gut fungal isolate and its animal source

(Rajendran D)

Distribution of microbial cultures to researchers across India

National Centre for Veterinary Type Cultures is mandated to work on acquisition, authentication, preservation, documentation, and repository database management of animal microbes. After the *ex situ* conservation of the microbial cultures, the distribution of microbes for teaching, research and development of new technologies is another core mandated activity of NCVTC. The repository has increased its distribution of culture activity to researchers across India following codal formalities like material transfer agreement. During the year 2018-19, 25 bacterial cultures were distributed to 8 Institutes in different states of India for research and teaching purposes. Cultures were sought by researchers at Deputy Commissioner of Animal Husbandary, Goregaon, Mumbai, Maharashtra; Dept of VPH, GC Negi College of Veterinary Sciences, Himachal Pradesh; Dept. of Animal Biotech., GADVASU, Ludhiana; College of basic Sciences, CCS HAU Hisar; Dept. of VPHE, LUVAS, Hisar. Cultures distributed included *Aeromonas hydrophila, Bacillus cereus, E. coli*, *Salmonella* Paratyphi, *Salmonella* Typhimurium, *Staphylococcus aureus, Bacillus subtilis, Bacillus cereus, Streptococcus agalactiae*, *Listeria monocytogenes* and *Pseudomonas aeruginosa.* In addition, different cell lines (MDCK, BHK-21, Vero, and A-72) and viruses (Bluetongue virus and Infectious bursal disease virus) were also distributed to various research institutes for teaching and research purpose.

Technology Development
Transfer and Commercialization

Since its inception, the Centre has made focused efforts for the development of advanced technologies for improvement in equine health, production and their utilization by the stakeholders and striving for upliftment of equine sector. Many diagnostic kits, vaccines and biologicals developed by the scientists of ICAR-NRCE are being used in the field. Many of the novel technologies are under development, transfer and commercialization.

Technologies for commercialization

- Updated equine influenza vaccine.
- Inactivated equine herpesvirus-1 vaccine (Equiherpabort).
- Equiherpes B-ELISA kit for diagnosis of EHV-1 infection.
- Monoclonal antibody-based ELISA kit for diagnosis of rotavirus infection.
- Recombinant antigen ELISA kit for *Theileria equi* diagnosis.
- Recombinant protein based ELISA for diagnosis of glanders.
- Recombinant protein based ELISA for diagnosis of EIA.
- Pregmare kit for pregnancy diagnosis in mares.
- Cryopreservation of equine semen.
- Lateral flow assay for rapid diagnosis of *Theileria equi* diagnosis.
- Recombinant gG based type specific ELISA for differentiation of EHV-1 and EHV-4 infection.

Technologies being developed

- Recombinant protein based ELISA for diagnosis of *Trypanosoma evansi*.
- Lateral flow assay for diagnosis of *Trypanosoma evansi*.
- Lateral flow assay for pregnancy diagnosis in mares.
- Monoclonal antibody-based sandwich ELISA for equine influenza virus.

TECHNOLOGY DEVELOPMENT & ASSESSMENT

Development of recombinant-protein-based iELISA for JEV antibodies

Indirect ELISA was developed using JEV-E protein immunodominant epitope of 444 bp expressed in *E. coli* (BL 21 (DE3) cells using pET 32a vector, for detection of JEV specific antibodies in horse and pig.

The recombinant protein was produced in bulk, purified and stability was tested and was found to be stable for one year at -20^{0}C. The assay has been transferred to Core Lab-I and is used for validation on pig serum samples. The results from the Core Laboratory by HI and ELISA indicated that the assay is working satisfactorily in the Core Laboratory.

The ELISA was transformed to a diagnostic kit for detection of JEV antibodies in equines. The kit stability has been tested satisfactorily for 6 months. The internal validation of the kit was got done from three laboratories and results indicate good agreement. More than 350 samples of horse, donkey and mules and pig have been tested for JEV by ELISA and results have been compared with HI and VNT.

(BR Gulati, Sarika Punia & BN Tripathi)

Development of nested and real-time PCR assays for detection of EHV-1 latency

In order to diagnose latent EHV-1 infection, nested (gB-nPCR) and real-time PCR (gB-qPCR) targeting gB were standardized. EHV-1 gB-nPCR was developed that amplified 188 bp of glycoprotein B. The assay sensitivity was determined to be 1340 fg or 4.1 x 10^3 gene copies.

For gB-qPCR standard curve was generated with serial 10-fold dilutions of EHV1/V592 DNA template. From the standard curve, the slope was calculated as -3.658 and the correlation coefficient (R2) was found out to be 0.999. By using obtained Cq value and slope, the amplification efficiency was calculated to be 87.7%. The sensitivity of the real-time assay was found to be 13.4 fg or 41 copies. Both the assay was found to be specific for EHV-1 and did not react with other equine DNA viruses viz. EHV-4/Hisar and EAdV/H9.

Relative sensitivity and specificity of the gB-nPCR assay for EHV-1 latency was estimated by comparing with that of gB-qPCR for detection of EHV-1 gB. The sensitivity and specificity of gB-nPCR were 46.66% and 100%, respectively. The findings establish that the real-time PCR is a sensitive and specific assay for ante-mortem detection of EHV-1 latency in equine population.

(BR Gulati & N Virmani)

Isolation and cryopreservation of spermatozoa from stallion epididymis

After gelding of the stallions, the epididymis from the testis was recovered using microsurgery techniques. From the isolated epididymis the spermatozoa were successfully recovered either using the retrograde flushing method or floating up technique. The qualitative analysis of the spermatozoa was done using CASA for their morphometry and kinematic properties. Later these spermatozoa were cryopreserved using either Glycerol or DMF as cryoprotectants. The extended epidymal spermatozoa were cryopreserved using INRA® and Egg yolk extenders using traditional methods of vapor freezing technique and stored in LN_2 (Fig.1 A - D). This technique is highly useful in conserving the equine germplasm even after the death of the elite stallion.

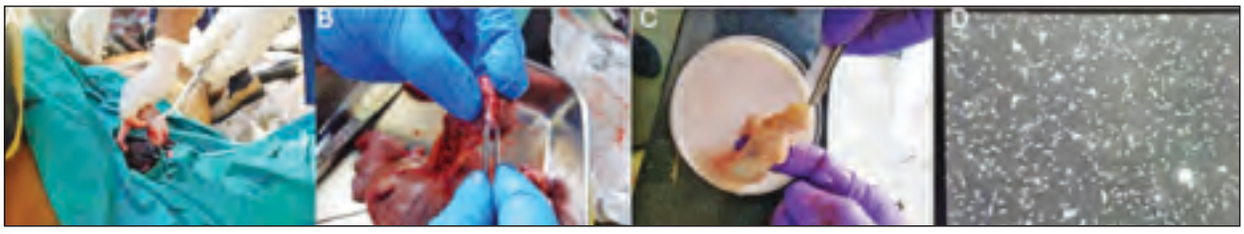


Fig. 1 : Isolation and cryopreservation os stallion epididymal spermatozoa. A. Process of gelding. B retrograde flushing of epididymis. C. floating up technique for recovery of epididymal spermatozoa. D CASA analysis of epididymal spermatozoa.

(TR Talluri, Dinesh Jhamb, RA Legha, J Singh & SC Mehta)

Prototype of customized Artificial Vagina for semen collection in stallion

Commercially available artificial vaginas for semen collection of stallions are quite expensive and imported by only limited firms in India. Here we have developed a prototype of customized artificial vagina for collecting the semen from the stallions using available material in the local market Fig.2. This AV is being successfully used for routine semen collection at EPC and is proved to be handy and light in weight compared to that of the commercially available AVs.

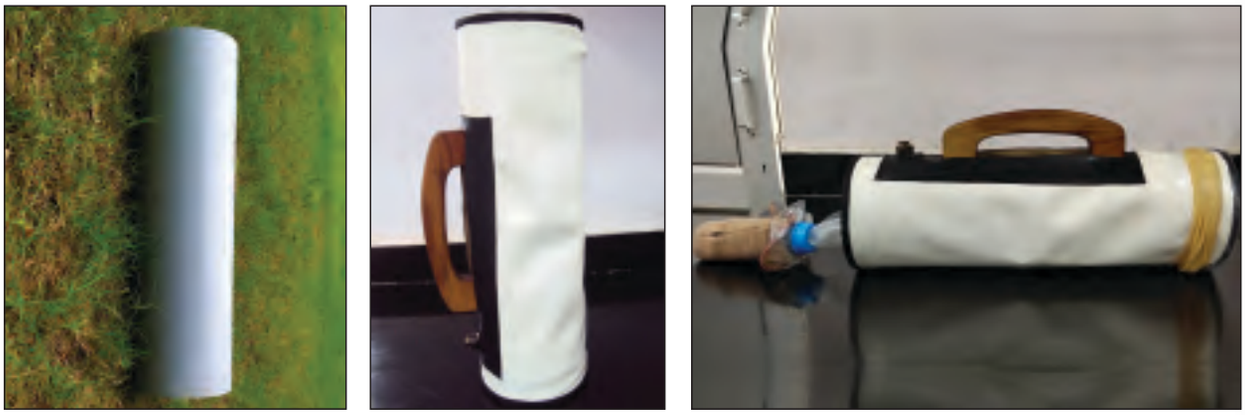


Fig. 2 : Prototype of customized AV for stallion semen collection.

(TR Talluri, SK Ravi & RA Legha)

Applications of donkey milk in terms of donkey milk based soaps, body butter and lip balms for its promotion

NRCE has standardized the formulations and technology for production of donkey milk based soaps, body butter and lip balms. In view of promotion of donkey milk along with generating awareness among equine farmers and donkey keepers for benefits of donkey milk and getting economic gain from it NRCE scientist made efforts to standardize the formulations and methodology for making soap and body butter using donkey milk (Fig.3). The package of practices will be available soon to the stakeholders and Agri- entrepreneurs. The soaps were made by HP and CP methods utilizing the benefits of olive oil, coconut oil, castor oil and essential oils along with other key ingredients. Fresh frozen donkey milk and freeze dried donkey milk was used for making the formulations. The soaps have been tested for organoloeptic properties, cleansing, and lathering properties. The body butter were made by using freeze dried donkey milk, beeswax, coconut oil, clarified butter oil, Shea butter, vitamin E and aloe vera gel along with essential oils. The lip balms were made by using freeze dried donkey milk, coconut oil, clarified butter oil, shea butter, vitamin E and sweet almond oil along with essential oils.

Fig. 3 : Donkey milk based soaps, body butter and lip balms

(Anuradha Bhardwaj, Yash Pal, Varij Nayan, RA Legha, Hema Tripathi & BN Tripathi)

RELEASE OF TECHNOLOGIES

Release of two NRCE technologies by Union Minister of Agriculture & Farmers Welfare

Two technologies developed by NRCE were released by Hon'ble Union Minister of Agriculture & Farmers Welfare, Sh. Radha Mohan Singh Ji and other dignitaries on 9th January, 2019 at Krishi Bhawan, New Delhi (Fig.4).

1. ELISA for diagnosis of glanders

NRCE has been able to develop a recombinant Hep1 antigen ELISA as an alternate to Complement-Fixation Test (CFT). The ELISA has been duly validated in India and the OIE Reference Laboratory, Germany and showed excellent sensitivity (97.2%) and specificity (99.6%). This technology has been transferred to 8 State Disease Diagnostic Laboratories following approval of DADF, Ministry of Agriculture & Farmers' Welfare and commercialized for

transformation into ready to use kit. The ELISA has a huge potential of international commercialization as recombinant protein-based ELISA is not available in any other country. This technology will prove to be a milestone in controlling and eradicating Glanders from India.

2. ELISA for diagnosis of Equine Infectious Anaemia

NRCE developed recombinant p26 protein-based ELISA as an alternative to Coggin's test. This technology will provide sustainable and homogeneous source of antigen and harmonized protocol for ensuring regular surveillance of EIA. The kit is highly economical as compared to imported kit.

Fig. 4 : Releasing of **'Glanders ELISA Kit'** and **'Equine Infectious Anaemia ELISA Kit'** by Shri Radha Mohan Singh Ji, Hon'ble Minister of Agriculture & Farmer's Welfare, Govt. of India on 9th January 2019 at Krishi Bhawan, ICAR, New Delhi.

Patent granted/filed

1. Patent granted

Nano-drug delivery for quinapyramine sulphate (Patent No.310429, Application, No.2560/DEL/2011, dated 06.09.2011). Name of Inventors: Anju Manuja, Neeraj Dilbaghi, Sandeep Kumar, Harmanmeet Kaur, Gaurav Bhanjana, Rajender Kumar, Balvinder Kumar and SC Yadav.

2. Patent filed

S.No.	*Title*	Name of Inventors	Application Detail
1.	*Aerva javanica* extract for the treatment of exuberant granulation tissue and tumors in horses.	Ramesh Kumar Dedar, Naveen Kumar and BN Tripathi	Application No.201811048899, dated 24.12.2018. (provisional)
2.	Polymeric metal nanocomposites and methods of synthesis thereof	Anju Manuja, Balvinder Kumar, Riyesh T. and BN Tripathi	Application No.201911009696, Dated 13.03.2019

MoU for cooperation in Research and Education

The ICAR-NRCE, Hisar inked the Memorandum of Understanding with the Chaudhary Charan Singh Haryana Agricultural University, Hisar and GLA Mathura for the cooperation in the areas of Research and Education (Fig. 5). Dr. BN Tripathi Director NRCE, Hisar and Vice Chancellors of the Universities signed the Memoranda.

With the MoU, the NRCE and Universities have agreed for collaborative programmes in the fields of research, education, training and capacity building, extension consultancy and other areas of national interest. Both the partners have also agreed for mutually recognizing the faculty of both the Institutes for the research and teaching purposes, wherein, the students and faculties can carry out the specific, research and outreach activities at the laboratories of these institutions.

Fig. 5 : Dr KP Singh Vice Chancellor CCS HAU, Hisar & Dr BN Tripathi Director NRCE exchanging the MoU documents.

Revenue generation under diagnostic services and consultancy

During the year 2018-19, contractual diagnosis services were offered to stakeholders of the country. A total 9517 samples received from race courses, turf clubs, stud farms, riding schools and other organized sector were tested on payment basis. The details of the samples for diagnosing the various diseases and revenue generation from the diagnostic services were listed as in the given Table.

Table: No of samples tested and income generated during 2018-19

Disease	No. of samples tested	Amount (in Rs)
Equine Infectious Anaemia	3764	1958250.00
Glanders	5176	3329400.00
Equine Herpes Virus-1	14	28000.00
Trypanosoma evansi	24	12000.00
Equine Influenza	25	12600.00
Dourine	84	86400.00
Japanese Encephalitis/West Nile Virus	16	8000.00
Equine Piroplasmosis	96	138850.00
African Horse Sickness	55	57200.00
Equine Viral Arteritis	77	154000.00
Contagious Equine Metritis	186	284600.00
Total	**9517**	**60,69,300.00**

LANDMARK ACHIEVEMENTS

Year	Achievement
1985	Foundation of NRCE, Hisar
1987	Detection of first outbreak of equine influenza in northern India
1989	Establishment of Equine Production Campus, Bikaner
1990	Import of Poitou donkey from France
1995	Cryopreservation of Jack semen for AI
1996	Establishment of a herd of Marwari horses
1996	Crystal structure of mare milk lactoferrin
1996	Production of carpet fabric by blending of donkey and sheep hair
1997	Release of inactivated equine influenza vaccine
2002	Cryopreservation of Marwari stallion semen
2003	Award of Indian patent to HERP kit for diagnosis of EHV1 infection
2005	Development of mAb-based sELISA for detection of rotavirus
2005	Establishment of National Centre for Veterinary Type Cultures (NCVTC)
2006	Collection and cryopreservation of stallion semen at farmers' door
2006	Detection of outbreak of Glanders in equines
2008	Detection of second outbreak of equine influenza
2008	Release of 'Equiherpes B-ELISA' kit for EHV1 diagnosis
2008	Release of 'Pregmare kit' for pregnancy diagnosis in mares
2009	Establishment of a herd of Zanskari ponies
2009	First report of Camelpox zoonosis
2010	Re-emergence of a case of equine infectious anemia
2010	Cryopreservation of Zanskari Stallion semen
2010	Developed donkey/mule drawn agricultural implements for arid region
2011	First report of Buffalopox virus causing concurrent disease in cow, buffalo and human
2011	Whole genome sequencing of Japanese Encephalitis virus isolated from a horse
2011	Whole genome sequencing of Pasteurella multocida B:2 strain
2011	Establishment of a herd of Small grey & Large white indigenous donkeys
2012	Organization of SAARC trainings on equine piroplasmosis under OIE Twinning Program
2012	Quinapyramine sulfate nanoformulation developed against Trypanosoma evansi
2012	Development of r-protein based ELISA for equine infectious anemia
2012	Whole genome sequencing of *B. bronchiseptica, P. multocida, A. equuli, Salmonella gallinarum*
2012	Technique for Vermicomposting using equine dung optimized
2013	Establishment of Microbial Containment Laboratory (BSL-3)
2013	Establishment of ATIC and info-Equine Museum
2013	Establishment of a herd of Manipuri ponies
2014	Development of r-protein based ELISA for diagnosis of *Burkholderia mallei*
2014	Development of recombinant Ag based ELISA for *Trypanosoma evansi* infection
2015	NRCE conferred Sardar Patel Outstanding ICAR Institution Award
2015	Release of 'Equiherpabort vaccine' for prevention of EHV1 abortions in mares
2015	Release of r-protein based *Theileria equi* antibody detection kit
2015	Whole genome sequencing of classical swine fever virus
2016	Organization of SAARC trainings on equine influenza and glanders under OIE Twinning Programme
2016	Release of updated equine influenza vaccine
2016	Methodolgy for isolation of RNA virus from mixed infection developed
2017	Establishment of a herd of Kathiawari horses
2017	Glanders ELISA validated in OIE laboratories
2017	Glanders ELISA transferred to states
2017	Whole genome sequencing of *Burkholderia mallei*
2018	Ecotourism started at Equine Production Campus, Bikaner
2018	Release of ELISA kits for EHV1/4
2018	Release of LFA for equine piroplasmosis
2018	Parentage Testing Technology developed
2019	Release of Glanders ELISA kit.
2019	Release of EIA ELISA kit.
2019	Generation of recombinant EIV through reverse genetics.
2019	Development of deletion mutants EHV-1 using BAC technology.

Education and Trainings

A. HRD trainings attended by the NRCE staff

NRCE encourages its staff for capacity building in newer scientific field, administrative updating and personality development. This year following scientists, technical and administrative staff were trained as detailed below:

Sr. No.	Name of the Staff	Category	Area of training attended	Place of training institute	Duration of the training
1.	Dr Sanjay Kumar	Scientific	Drug discovery methodology	Indraprastha Institute of Information Technology, Delhi	Five days
2.	Dr BC Bera	Scientific	Gene manipulation and editing	Guru Jambheshwar University of Science and Technology, Hisar	Ten days
3.	Dr BC Bera	Scientific	Drug discovery methodology	CSIR-Institute of Microbial Technology, Chandigarh	One day
4.	Dr HS Singha	Scientific	Analytical Veterinary Epidemiology	ICAR-NIVEDI, Bengaluru	Three days
5.	Dr RK Vaid	Scientific	Antimicrobial Susceptibility Test and WHONET for AMR Surveillance	IVRI, Izatnagar, Bareilly	Three days
6.	Dr RK Vaid	Scientific	Assessment Tool for Laboratory AMR Surveillance System (ATLASS) Assessors Training	Central Institute of Fisheries Technology. Kochi, Kerala.	Five days
7.	Dr Taruna Anand	Scientific	Gene manipulation and editing	Guru Jambheshwar University of Science and Technology, Hisar	Ten days
8.	Sh Sanjeev Kumar	Technical Officer	Motivation, positive thinking and communication skill	ICAR-NAARM, Hyderabad	Seven days
9.	Sh Joginder Singh	Technical Officer	Motivation, positive thinking and communication skill	ICAR-NAARM, Hyderabad	Seven days
10.	Sh Sunil	Assistant	Establishment and Financial matters	ICAR-NAARM, Hyderabad	Six days
11.	Sh Subash Chander	Assistant	Establishment and Financial matters	ICAR-NAARM, Hyderabad	Seven days

B. Education and trainings imparted by staff of NRCE

1. Training of Veterinary Officers on diagnosis of glanders by ELISA

To support state wide glanders surveillance programme 10 Veterinary Officers from three state disease diagnostic laboratories namely Uttar Pradesh, Karnataka, and Jammu & Kashmir have been imparted hands on training on glanders diagnosis. A three days training programme was conducted twice between 12-14 December and 18-20 December 2018 (Fig.1). After successful completion of training glanders ELISA was provided to SRDDL, Karnataka and Kashmir for screening of equine glanders. Participants have expressed their satisfaction regarding quick and simple methodology of the ELISA for detection of glanders.

Fig. 1: Participants undergoing Hands on training

2. Training on vermicomposting for farmers was organized at ICAR-NRCE

Under a special campaign for propagating and encouraging organic farming one day training on "Vermicomposting using equine dung" was organized at ICAR-NRCE, Hisar on June 2019 (Fig.2). An expert lecture was delivered by Dr Hema Tripathi on the Vermicomposting, importance of organic manuring and controlled use of chemical fertilizers. Ten farmers belonging to various villages of Hisar were educated on organic farming and trained regarding vermicomposting using equine dung. Dr BN Tripathi, Director, ICAR-NRCE also addressed the gathering and emphasized on organic farming.

Fig. 2 : Lecture delivered on vermicomposting and organic farming to farmers and students

3. Dr. BR Gulati imparted an on-site trainings to Scientists and staff of north-eastern laboratories (COVS, Khanapara, Assam and NRC-Pig, Rani, Assam) on Diagnostic Assays for Japanese Encephalitis, including ELISA, hemagglutination inhibition, RT-PCR, etc by visiting Guwahati (December 15, 2018).

4. Dr TR Talluri and Dr J Singh imparted training to the 40 BVSc & AH internee students of Aravalli Veterinary College, Sikar, Rajasthan in Artificial insemination and pregnancy diagnosis in Equines. Also demonstrated the process of semen collection and cryopreservation methods in equines.

5. Dr RA Legha imparted training to the 40 internee students of RAJUVAS in management of Equines and demonstrated the vermicomposting process of equine dung to 25 farmers.

6. A training programme and meeting focused on the preparation of vermicompost was organized at EPC, Bikaner, Rajasthan on 30.6.2018. Ten farmers from adopted villages from Bikaner district attended the programme.

C. Agriculture students visited NRCE

Forty-five Students along with 3 faculty members from Harbilas Goyal Inter Collage Ujhani (Badaun), UP visited ATIC of ICAR-NRCE, Hisar on dated 27th Nov., 2018 (Fig. 3). The students were briefed about the different research activities going on at the Centre by a team of scientist and technical officer. Information was also provided about different breeds of equines and their use.

Fig. 3 : Students visited ATIC and briefed about the activities of the NRCE

D. Expert/invited lectures delivered by NRCE Scientists in Training courses/ conferences/symposia/workshops

1. Barua S delivered a lecture on "Molecular biology tools for authentication of microbial cultures" to the CAFT trainees in the training programme on "Molecular biology and bioinformatics tools and techniques" organized by Dept of Animal Biotechnology, LUVAS, Hisar during 04 - 24 September, 2018.
2. Barua S delivered an expert lecture on the topic "Scenario of emerging diseases and vaccination schedule to be followed in poultry farms of Ajmer district" upon invitation of Department of Animal Husbandry, Govt. of Rajasthan, Ajmer, on 31 August, 2018.
3. Barua S delivered a lecture on "Inhibitor of sarco/endoplasmic reticulum calcium-ATPase impairs paramyxovirus replication" in Second international Conference on Contemporary Antimicrobial Research, organized by IIT Kharagpur in collaboration with Society for Antimicrobial Research at IIT Kharagpur, 15-17 December, 2018.
4. Gulati BR presented a lead paper entitled "Genetic diversity of equine herpesviruses from clinically and latently infected equines in India" in XXV Annual Convention of Indian Society of Veterinary Immunology and Biotechnology (VIBCON-2018) & National Symposium on "Innovative Biotechnological Approaches for Improving Animal Health and Productivity" at ICAR-National Research Centre on Mithun, Medziphema, Dimapur, Nagaland, 13-15 December 2018.
5. Gulati BR presented a lead paper entitled "Japanese Encephalitis in Animals: An Indian Perspective" in 27th International Conference of Virology of Indian Virological Society (Intervirocon-2018), PGIMER, Chandigarh, November 12-14.
6. Gulati BR presented an invited paper entitled "Diagnosis and control of important infectious diseases in India" in One Day Symposium of Indian Association of Veterinary Microbiologists, Immunologists and Specialists in Infectious Diseases (IAVMI) on 'Advances in Equine Health & Management', ICAR-National Research Centre on Equines, Hisar, 27 February 2019.
7. Kumar N delivered a lecture on "Laboratory viral stocks: How much we are sure of contamination" in training on "Recent Advances in cell based technologies for animal disease diagnostics and therapeutics" organized by Department of Veterinary Microbiology, ICAR-Centre for Advance Faculty Training (CAFT) LUVAS, Hisar from 11-31 October, 2018.
8. Kumar N delivered a lecture on "Oncogenesis: oncogenic and oncolytic viruses" in ICAR sponsored summer school organized at Department of Surgery, LUVAS, Hisar from 1-21 August, 2018.
9. Kumar N delivered a guest lecture on "Studying virus-host interactions: Development of novel antiviral therapeutics" at training programme on "Diagnosis of livestock diseases: a molecular approach" held at Department of Animal Biotechnology, LUVAS, Hisar in training organized by the department from 07- 31 April, 2018.
10. Legha RA delivered an invited lead lecture on "Fodders in equine: issues and solutions" in XI Biennial Conference (ANACON-2018) on a theme Reorienting Animal Nutrition Research in the Perspective of Farmers Welfare at Patna during 19-21 November, 2018.
11. Mehta SC delivered an invited talk on "Present Status of Equine Genetic Resources in India" in Summer School on Conservation of Indigenous Livestock Germplasm: An AVANT-GARDE approach to success held at Department of Animal Genetics & Breeding, Madras Veterinary College, Chennai during 2-22 May, 2018.
12. Manuja A delivered an invited lecture on "Nanobased Delivery Vehicles and Potential Applications in Animals" in CAFT training on "Molecular Biology and Bioinformatics Tools and techniques" held at Department of Biotechnology, LUVAS, Hisar during 4 - 24 September, 2018.
13. Manuja A delivered an invited lecture on "Nanobased Delivery Vehicles and Potential Applications in Animals" in CAFT training on "Cell Culture Based Molecular Biology & Nanobiotechnological Tools & Techniques" held at Department of Biotechnology, LUVAS, Hisar during 5 - 25 February, 2019.

14. Manuja A delivered an invited lecture on Metabolic/ non-infectious diseases of Equines and their management." in Symposium on "Advances in Equine health & Management" on Feb 27, at NRCE Hisar.
15. Mehta SC delivered a talk on "Fodder Management for Equines" at winter school on "Fodder Management Strategy for Sustainable Livestock Production under Climate Change Scenario" organized by Institute of Agri-business Management, SKRAU, Bikaner on September 11, 2018.
16. Mehta SC presented a lead paper on "Utilization of indigenous animal genetic resources for rural socio-economic security" at National Symposium on Animal Genetic Resources for Food and Social Security organized by the Society for Conservation of Domestic Animal Biodiversity and National Bureau of Animal Genetic Resources, Karnal at Karnal, Haryana on 7-8 February, 2019.
17. Pal Y delivered a talk as an expert and resource person recorded on "Rashtriya Ashav Anusandhan Par Radio Report" by Aakashvani, Hisar on 26 November, 2019.
18. Pal Y delivered an invited lecture on "Pregnancy Diagnosis in Mares" in XXVII Annual conference of Society of Animal Physiologists of India, ICAR-NDRI, Karnal, 27-28 November, 2018.
19. Pal Y participated in an interactive discussion and talk on "Utility of donkey milk" for Kisanvani on National Science day and broadcasted on 5 March, 2019.
20. Talluri TR delivered invited lectures on "Semen collection and cryopreservation in equines" and "Equine Reproduction", in workshop conducted on Semen collection and cryopreservation in Equines, at College of Veterinary Science, GADVASU, Ludhiana during 23-29 March, 2019.
21. Talluri TR delivered an invited lecture on "Induced Pluripotent stem (iPS) cells and their derivation" at ICAR Sponsored Course on Laparoscope aided artificial insemination and embryo transfer in Sheep held at CSWRI, Avikanagar during 14-23 Jan 2019.
22. Tripathi BN attended a workshop on "Status of Glanders and its Eradication" at National level and "Presented a detailed National Plan for Glanders Eradication in the country" at CMVL, Meerut on April 9, 2018.
23. Tripathi BN delivered an expert lecture on "Equine Management and Practices in India and NRCE profile" to the participant scientist of ICAR sponsored summer course at LUVAS, Hisar on August 10, 2018.
24. Tripathi BN delivered a lecture on "Anthrax about control and diagnoses in India'" in 2nd Expert Group meeting for formulation of DBT Anthrax Network Program held at IAH & VB, Bangaluru for evaluation of pre-proposals submitted by the scientists on December 10, 2018.
25. Vaid RK delivered a lecture on 'Animal Microbial Diversity' at National Workshop on Sustainability of Indian Agriculture: Biodiversity, Environmental and Climate Change Perspectives, organised by ICAR-National Institute of Agricultural Economics and Policy Research at NASC Complex, New Delhi on 26 November, 2018.
26. Vaid RK delivered a lecture on 'Gandhi ji ka Bharat ke swatantrata aandolan me yogdaan' in Program commemorating 150th Birth Anniversary of Mahatma Gandhi in NRCE, Auditorium on 2 October, 2018.
27. Vaid RK presented paper on 'Outbreak of mastitis in buffalo and cattle herds and detection of methicillin resistant *Staphylococcus aureus* and ESBL-producing Gram-negative bacilli, in the XIV Agricultural Science Congress 2019 held during 20-23 February, 2019.
28. Vaid RK presented report for NCVTC, ICAR-NRCE, Hisar Annual Report in Network meet of NCVTC Annual Review Meet held on 03 August, 2018.

Foreign Visit by Scientists

- Dr Taruna Anand visited USA for availing International "WISTEMM Indo-US fellowship" for a period of 3 months sponsored by Department of Science and Technology, Govt. of India and Indo-US Science and Technology Forum (IUSSTF) at The Rockefeller University, New York during 03 September – 30 November, 2018.
- Dr Anju Manuja was awarded a Grant by International Consortium on Regenerative Rehabilitation (ICRR), University of Pittsburgh, USA for participating in the symposium on "Regenerative Rehabilitation" organized at Seattle, USA during 11-13 October, 2018.

F. Post Graduate Student's Research and Guidance

Sr. No.	Name of the Student	Name of the Guide	Title of the Thesis
PhD Students			
1.	Venkatramrireddy Balena ICAR-IVRI, Izatnagar	Dr BN Tripathi	Generation of recombinant equine herpesviruses 1 through BAC mediated deletion mutagenesis and their comparative pathogenicity and immunogenicity in murine model
2.	Rhushikesh S Khetmalis ICAR-IVRI, Izatnagar	Dr BN Tripathi	Assessment of antiviral effect of selected drug molecules in mitigating pathology induced by equine influenza virus infection in murine model
3.	Rakesh Kumar ICAR-IVRI, Izatnagar	Dr BN Tripathi	Yet to be decided
4.	Himanshu Sharma LUVAS, Hisar	Dr BR Gulati	Studies on latency in equine herpesvirus-1 infection among equines in India
5.	Stephanie S Pradhan ICAR-IVRI, Izatnagar	Dr Nitin Virmani	Comparative pathogenicity and immunogenicity of modified live EHV-1 vaccine candidate(s) in mouse model and development of gE protein based ELISA for differentiation of vaccinated and infected animals
6.	Sumitra Panigrahi LUVAS, Hisar	Dr Sanjay Barua	Isolation, molecular characterization and whole genome sequencing of Newcastle disease virus from backyard poultry
7.	Deepak Kumar Sharma, RAJUVAS, Bikaner	Dr Naveen Kumar	Kinetics of inflammasome activation following exposure to peste des petits ruminants virus.
8.	Kruti Debnath Mandal, ICAR-IVRI, Izatnagar	Dr Sanjay Kumar	Evaluation of *Acacia nilotica* & *Phyllanthus niruri* plant extracts for in vitro antipiroplasmal activity against *Theileria equi*.
9.	Alka Galav, RAJUVAS, Bikaner	Dr Naveen Kumar	Epidemiology of PPRV in Rajasthan and role of DUSP1 and KDMA6 in PPRV replication.
10.	Sheetal Saini CDLU, Sirsa	Dr Harisankar Singha	Expression of recombinant equine cytokines and analysis of their biological activities
11.	Ashok Kumar, RAJUVAS, Bikaner	Dr TR Talluri	Evaluation of various parameters affecting semen quality in Marwari stallion.
12.	Dinesh Jhamb, RAJUVAS, Udaipur	Dr TR Talluri	Effect of L-arginine and trehalose supplementation to semen extender on quality and fertility of cryopreserved stallion semen.
13.	Medhavi Vashisth CCS HAU, Hisar	Dr Taruna Anand	Characterization of bacteriophages against ESKAPE pathogens and assessment of their synergy with antibiotics

MVSc/MSc Students			
1.	Wangchuk Dorjee Bhutia, ICAR-IVRI, Izatnagar	Dr Rajender Kumar	*In vitro* evaluation of anti-trypanosomal activity and cytotoxicity of some novel target specific drug molecules.
2.	Pragya LUVAS, Hisar	Dr Sanjay Barua	Detection & experimental studies on astroviruses in broiler chicken
3.	Parbha Yadav LPU, Jalandhar	Dr Anuradha Bhardwaj	Determination of antioxidant activity of indigenous and Poitou donkey milk and donkey milk powder.
4.	Manish Songara RAJUVAS, Bikaner	Dr RA Legha	Effect of dietary inclusion of azolla on nutrient utilization and semen quality of Marwari stallions.
5.	Ram Kumar RAJUVAS, Bikaner	Dr Naveen Kumar	Role of MNK1 in buffalopox virus replication.
6.	Anand Kumar RAJUVAS, Bikaner	Dr TR Talluri	Effect of season on the expression of fertility marker genes in Marwari stallion sperm.
7.	Dharvi Chhabra LPU, Jalandhar	Dr B Kumar	Molecular diversity of Indian isolates of *Streptococcus equi*.
8.	Lalit Kumar RAJUVAS, Bikaner	Dr RK Dedar	Screening of in-vitro antibacterial activity of extracts of various locally available plants in Bikaner against *Rhodococcus equi*.
9.	Dinesh Barsiwal RAJUVAS, Bikaner	Dr RK Dedar	Assessment of risk factors for *Rhodococcus* equi in foals.

Workshops, Seminar and Institutional Activities

World Veterinary Day celebration

Dr Panjab Singh, delivering the CM Singh memorial lecture on "Indian agriculture challenges and resolves"

ICAR- National Research Centre on Equines celebrated - **'World Veterinary Day'**, in collaboration with Dr C.M. Singh Endowment Trust, Bareilly on 28th April, 2018. A seminar was organized on "Role of Veterinary profession in sustainable development to improve the livelihood, food security and safety". Dr Panjab Singh, Former DG, ICAR and Secretary DARE and Vice Chancellor of Rani Lakshmi Bai Central Agriculture University, Jhansi was the Chief Guest on the occasion, while Dr SK Garg, Founder Vice Chancellor Deen Dayal Upadhyaya Veterinary and Animal Science University and Dr MC Sharma, Former Director IVRI and Chairman, Bureau of Indian Standards were Guests of Honour.

Dr Panjab Singh gave the CM Singh memorial lecture on "Indian agriculture challenges and resolves". On this day Dr CM Singh samman was bestowed to Dr SK Garg, while Dr CM Singh Salihotra samman award was conferred on Dr BK Singh, Principal Scientist (retd), NRCE; Dr Sandeep Khurana, Principal Scientist, CIRB. Dr JR Sadana and Dr Prem Singh, Professor (retd) LUVAS, Dr Gajraj Singh, Ex-Dean, Central Agricultural University, Aizawl. On this occasion lectures were delivered by scientists from NRCE-NCVTC, CIRB and LUVAS.

NRCE organized symposium on "Advances in Equine Health and Management"

Release of compendium during symposium on "Advances in Equine Health and Management"

ICAR-National Research Centre on Equines (NRCE) in collaboration with Indian Association of Veterinary Microbiologists, Immunologists and Specialists of Infectious Diseases (IAVMI), organized one day symposium on **"Advances in Equine Health and Management"** at ICAR-NRCE, Hisar on 27th Feb., 2019. Prof. RK Yadav Chairman Haryana Farmers Commission was Chief Guest on the occasion. Maj. Gen. Shrikant Sharma Ex. Vice-Chancellor LUVAS; Prof. MP Yadav, Ex. Vice-Chancellor SVPUAT, Meerut; Prof. PK Uppal Ex. Director NRCE were Guests of Honours. Dr BN Tripathi, Director NRCE was the organizing secretary of the function. The symposium provided an excellent opportunity to Scientists, Veterinarians particularly the equine practitioners, progressive equine farmers and students to share their experiences about health and management of equines and interacting with eminent Scientists. An elite group of equine specialists and researchers shared their views in the Symposium. A total of 148 delegates from more than 9 states of India participated in the symposium. The delegates included Scientists from Universities, Executives from Industry, Representatives of Indigenous Horse

Breeding Society of India, Remount Veterinary Corps, Brooke Hospitals, RDDL, HLDB and ICAR institutes, Veterinary Officers from state Governments, Research Associates, Students and private equine practitioners.

Organization of Equine Health Camps and Kishan Gosthi by NRCE team

A multidisciplinary team of scientists and technical officers from ICAR-National Research Centre on Equines, Hisar organized an Equine Health Camps and Kisan Goshtis at villages Jakhod Khera on October 16, 2018 and at Sadalpur and Adampur Hisar (Haryana) on December 6, 2018. A total of 15 equines from both the camps were examined for various ailments and on-spot treatment was provided. De-worming tablets and mineral mixture packets were provided to the equine owners. The bio-samples were also collected from all available equines for disease epidemiological studies. The NRCE team responded to various queries on health and management of equines and provided solutions to equine owners. The farmers were acquainted about de-worming schedule, prevention and management of ticks, colic, lameness and feeding practices in equines. The equine owners were also briefed about management, housing, hoof care and grooming of animals.


Examination of equines during Equine Health Camp and organization of Kisan Gosthi

World Soil Day celebration

Farmers were educated about soil health

ICAR-National Research Centre on Equines organized "World Soil Day" at Village Kajla (Hisar) on December 05, 2018 to educate the farmers regarding importance of soil conservation and controlled use of insecticides, herbicides and chemical fertilizers. During this occasion a team of Scientists and technical officer from the centre visited the village. Expert lecture was delivered by Dr. Rajeev Bhatia (Agriculture Development Officer), Department of Agriculture, Government of Haryana. About 20 farmers attended the programme. The NRCE team and expert also responded to various queries and answered the questions of farmers.

Equine Production Campus, Bikaner celebrated Foundation Day

The 30th Foundation day of Equine Production Campus was celebrated with great enthusiasm and pride on 28th September 2018. On this occasion Equine Owners' and Tourism-Stakeholders' Meet was organized. Twenty equine farmers and 25 tourism-stakeholders participated in the meet. Hono'ble Vice-chancellor, SKRAU, Bikaner Dr BR Chhipa was the Chief Guest.

Release of NRCE-EPC Newsletter on the occasion of Foundation Day Celebration

Interactive meeting with farmers, stakeholders and hoteliers during Foundation Day Celebration of EPC (NRCE)

NRCE celebrated Foundation Day

The 34th foundation day of ICAR-NRCE was celebrated on November 26, 2018. Dr M. P. Yadav, Former VC, SVBPUAT and Ex Director IVRI&NRCE was the Chief Guest and Dr SS Dahiya, Acting Director, CIRB was the Guest of Honour. Dr A.K. Srivastava, Chairman, ASRB delivered the foundation day lecture on **"Food and nutritional Security of 1.34 billion Indians"**. Dr BN Tripathi, Director NRCE presided over the function and apprised the dignitaries about the research activities and accomplishment of the Centre. On this occasion, a Farmers-Veterinarians-Scientists Interface meet was also organized in which the farmers and veterinarians participated with enthusiasm.

International Yoga Day celebrated at NRCE

I. NRCE campus Hisar: A two-day Mass Yoga Performance Camp was organized at NRCE Lawns daily morning (5.45 AM-7.00 AM) from 20-21 June 2018 for conducting Yoga activities as per Common Yoga Protocol of Ministry of Ayush, GoI. In this Camp, all employees of NRCE practiced Yoga daily morning for one hour and fifteen minute, under the supervision of Yoga expert from *Patanjali Yog Samiti*, Hisar. The activities were conducted in to different sessions, including Prayer, body loosening & warm up exercises, followed by *yogasanas* in standing postures, sitting postures, prone postures, supine postures, followed by *pranaayam*, meditation and finally resolution for balanced life. Addressing the staff members on conclusion of Yoga camp, Dr BN Tripathi, Director NRCE emphasized the importance of Yoga in increasing the productivity of research scientists and also in the health and economy of the Country.

NRCE staff performing Yoga Aasnas on International Yoga Day

II. NRCE-EPC Bikaner Campus : International Day for yoga was celebrated at NRCE, Bikaner on June 21, 2018 under the slogan "Yoga for peace". Sh. Arjun Ram ji Meghwal Minister of State, Ministry of Finance, Government of India was the Chief Guest on this occasion and also participated in Yoga Aasnas. The main aim is to create awareness worldwide on the importance of staying fit and healthy. On this occasion, employees of NRCE practiced Aasnas and Pranayama as per Common Yoga Protocol.

MGMG activities by NRCE team

A total of seven villages (five at Haryana and two at Rajasthan) were adopted by ICAR-NRCE for the Mera Gaon Mera Gaurav (MGMG) programme. The various activities were undertaken in villages Gurana, Kajla, Kharia, Rajli, Muklan from Haryana and Belasar & Sheiksar from Rajasthan. The scientists of the Centre made efforts to coordinate agriculture, animal health related activities and social awareness programmes through developing linkages with government officials (Agriculture Development officers, Veterinary officers and Anganwari officials & workers), local village Panchayats and NGOs. During the period under report scientists made 19 visits to adopted villages. The teams organized various scientific activities viz., interface meeting, demonstrations and trainings. Eeducation of farmers on zoonotic diseases and demonstration of vermi-composting utilizing equine dung are to name a few. Scientists inspired and educated school children by delivering lectures on various topics related to science, personal hygiene, nutrition, cooking healthy meals, cleaniliness and maintenance of personal health and prevention of disease transmission. Advisories were given to the needy farmers and interactive meetings with equine farmers were also conducted. General awareness were created by apprising the villagers about various Govt programmes viz., Beti Bachao aur Beti Padao, Beti Janam utsav, Swachha Bharat Abhiyaan etc. Various national days like World soil health day, National Science day, National Productivity week etc, were celebrated in Villages adopted under MGMG.

Beti Janam Utsav Celebration

Scientist Interacting with Students

Summary of activities organised under MGMG

Name of activity	No. of activities	Participation
Visit to village by teams	21	499 (Farmers); 141 (Students)
Interface meeting/ Goshthies	18	710
Training organized	5	53
Demonstrations conducted	4	53
Mobile based advisories	3	3
Literature support provided	4	103
Awareness created	13	459
Total	**68**	**1880* (Farmers) & 141 (Students)**

*(Farmers and students attended one or more activities; therefore numbers may overlap)

Initiation of Aspirational Districts Programme under *Krishi Kalyan* at NRCE

The programme hinges on expeditiously transforming 115 districts that were identified from across 28 states, in a transparent manner. Under this programme scientists of NRCE visited Baran and Jaisalmer Districts of Rajasthan

and interacted with the equine owners and organized health camps to address the health issues and infertility among livestock.

Equine health camp & interactive meet at Rajasthan

Cleanliness of the campus and tree plantation under *Swacchata Abhiyan*

Under *swacchata abhiyan* programme regular and routine cleanliness drives were conducted at NRCE and EPC during this year and *swacchata* pledge was taken by all the staff members of the both campuses. Digitalization of office records and updating of pending files were also taken up as a part of this programme. *Swachhta* awareness at local level was carried out at main campus in residential colonies. Moreover, technical, young professionals, junior and senior research fellows were educated about proper disposal various types' wastes generated from the research laboratories. During this programme, residential colony members were educated about usage of waste water for kitchen garden, sewerage and water line cleaning, plastic free environment, organic farming and composting. Under this programme *swachhta* awareness on personnel hygiene, clean milking, control of disease spread, mosquito control was created among the villages of adopted villages. In addition, our staff members were also participated in the cleaning of Community Park located in the city. More than 1000 trees were planted in the campus

Swachhta activities at NRCE Hisar

Cleaning of the Campus under Swachchh Bharat Abhiyan at EPC, Bikaner

Conservation of equines initiative through Equine Ecotourism at EPC, Bikaner

Conservation and propagation of indigenous equine species / breeds through Ecotourism has been initiated. In last 17 months period 11659 visitors, 2429 farmers and students visited the Centre. The visitors had access to the technical information displayed about the equines at the Information Centre and Equine Museum of the campus. Herbal garden and Museum have been further strengthened to attract more tourists. Efforts were being made to give vide publicity of this activity by obtaining place in Wikipedia and Rajasthan Tourism pages. A revenue of Rs 6,69,350/- has been generated during the financial year.

केन्द्र में आयोजित हिन्दी पखवाड़ा 14 से 27 सितम्बर 2018

भारत सरकार की राजभाषा की विकासनीति के अंतर्गत गत वर्षों की भांति इस वर्ष भी राजभाषा कार्यन्वयन समिति के तत्वाधान में राजभाषा के प्रचार- प्रसार एवं सरकारी काम-काज में हिन्दी पखवाड़े का आयोजन डॉ० भूपेन्द्र नाथ त्रिपाठी, निदेशक की अध्यक्षता में 14 से 27 सितम्बर, 2018 तक किया गया । कार्यक्रम के प्रथम दिन व हिन्दी दिवस के अवसर पर एक हिन्दी कार्यशाला का आयोजन किया गया। डॉ० यशपाल ने हिन्दी कार्यशाला के उद्घाटन समारोह में उपस्थित हुए सभी अतिथिगणों और केन्द्र के सभी अधिकारियों एवं कर्मचारियों का स्वागत किया। इस कार्यक्रम में सुनीता श्रीवास्तव, प्रोफेसर गुरु जम्भेश्वर विश्वविद्यालय, हिसार ने विशिष्ट अतिथि के

रूप में अपना, वक्तव्य 'भगिनि निवेदिता का भारतीय राष्ट्रीयवाद में योगदान' पर दिया। कार्यक्रम के अध्यक्ष व केन्द्र के निदेशक डॉ० भूपेन्द्र नाथ त्रिपाठी ने अपने संबोधन में कहा कि अनेकता में एकता का स्वर हिन्दी के माध्यम से गूंजता है। जीवन में भाषा का सबसे अधिक महत्त्व होता है। विभिन्नताओं के बीच एक भाषा ही है, जो एकता का आधार बनती है और हम सभी को इस एकता के साधन का सम्मान करना चाहिए। इस दौरान विभिन्न ज्ञानवर्धक एवं रूचिपूर्ण हिन्दी प्रतियोगिताओं क्रमश: निबंध प्रतियोगिता, हिन्दी परिछेद अनुवाद प्रतियोगिता, हिन्दी श्रुतलेख प्रतियोगिता, हिन्दी आशुभाषण प्रतियोगिता, हिन्दी प्रश्नोत्तरी प्रतियोगिता, हिन्दी कविता पाठ एवं सुलेख प्रतियोगिता (संस्थान के अधिकारियों एवं कर्मचारियों के बच्चों के लिए) हिन्दी टंकण प्रतियोगिता आदि का आयोजन किया गया। निदेशक महोदय ने हिन्दी पखवाड़ा में बच्चों की प्रतिभागिता की सराहना की और उन्हें पुरस्कार देकर प्रोत्साहित किया। केन्द्र के निदेशक महोदय डॉ० भूपेन्द्र नाथ त्रिपाठी ने संस्थान के कर्मिकों को अधिकाधिक हिन्दी में कार्य करने के लिए प्रेरित किया। डॉ० अनुराधा भारद्वाज, हिन्दी अधिकारी द्वारा हिन्दी पखवाड़े के सफल आयोजन में योगदान के लिए धन्यवाद प्रस्ताव प्रस्तुत किया गया।

केन्द्र में हिन्दी कार्यशाला का आयोजन

विराट हास्य कवि सम्मेलन का आयोजन

राष्ट्रीय अश्व अनुसंधान केन्द्र, हिसार में दिनांक 26.09.2018 को हिन्दी पखवाड़े के अर्न्तगत एक 'विराट हास्य कवि सम्मेलन' का आयोजन किया गया जिसमें विभिन्न स्थानों से आए गणमान्य व वरिष्ठ हास्य कवियों ने अपनी हास्य रचनाएं सुनाकर कार्यक्रम में उपस्थित अपार दर्शक समूह को हँसी से लोट-पोट व मंत्रमुग्ध कर दिया। कार्यक्रम में आमंत्रित कवियों में दिल्ली से सर्वश्री यूसुफ भारद्वाज, चण्ड़ीगढ़ से श्री योगेन्द्र मुदगिल, झज्जर से मास्टर महेन्द्र सिंह, दिल्ली से ही श्री दीपक सैनी, फरीदाबाद से यशदीप कौशिक व हिसार से श्री महेन्द्र जैन ने शिरकत की। हास्य कला में निपुण व दर्शकों को अपने बेहतरीन लतीफों से चित करने में माहिर इन सभी प्रतिष्ठित कवियों ने सदन में उपस्थित सभी श्रोताओं का मन मोह लिया। पूरे कार्यक्रम के दौरान सभागार तालियों की करतल ध्वनि से गूंजता रहा। इस कार्यक्रम में हिसार स्थित विभिन्न केन्द्रीय कार्यालयों के निदेशक, विभागाध्यक्ष व अन्य विशिष्ट अतिथि भी मौजूद थे। सभी श्रोताओं ने पूरे कार्यक्रम की जमकर तारीफ की व कवियों द्वारा एक के बाद एक छोड़े गए हंसी के लतीफों ने तालियों की गूंज को थमने नहीं दिया व सम्पूर्ण कार्यक्रम के दौरान पूरा सदन हंसी से लोट-पोट होता दिखाई दिया। यूसुफ भारद्वाज के देसी अंदाज, योगेन्द्र मुदगिल की प्रभावशाली हास्य शैली, दीपक सैनी की मिमिक्री, मास्टर महेन्द्र सिंह का विशुद्ध हास्य विनोद, यशदीप कौशिक के विशिष्ट अंदाज व महेन्द्र जैन की दिल को छू लेने वाली गजल ने श्रोताओं को टस से मस नहीं होने दिया। दर्शकों को तनाव से मुक्ति दिलाने वाले ऐसे अनुपम कार्यक्रम को बार-बार आयोजित करने की अपील की। केन्द्र के निदेशक डॉ० भूपेन्द्र नाथ त्रिपाठी ने ऐसे अभूतपूर्व आयोजन के लिए केन्द्र की आयोजक समिति के सदस्यों को बधाई दी व देश में हिन्दी की उपरोत्तर प्रगति की कामना की ।

Independence Day celebrations at ICAR-NRCE

NRCE celebrated Independence Day on 15 August, 2018 in the Campus premises. After hoisting of the National Flag, Dr BN Tripathi, Director inspired the staff and families by commemorated the martyrs' struggle for freedom of the nation from the British's rule. While recalling the achievements of the institute for the year, Director congratulated the staff and inspired the staff to accomplish the new horizons in their scientific endeavour. The Institute auditorium reverberated with patriotic fervor and enthusiasm. The children brought the stage alive with their passion and love for the motherland.

Independence Day Celebration at NRCE

Centre celebrated Republic Day with gaiety and patriotic passion

NRCE celebrated Republic Day on 26 January, 2019 in the Centre. Dr BN Tripathi, Director, hoisted the National Flag. Dr BN Tripathi, Director

inspired the staff and families by commemorating a series of incidents in the history of India for the attainment of independence, making India a republic. To mark the day, children of the employees took pride in glorifying and celebrating the spirit of unity. On this occasion appreciation certificates and awards were presented to Dr Yash Pal, Dr Anju Manuja, Dr Anuradha Bhardwaj, Dr Harisankar Singha for best MGMG team. Also, Dr Harisankar Singha (Scientist), Sh KS Meena, (ACTO), Sh. PP Choudhury (Senior Technical Officer), Dr RA Pachori (Senior Technical Officer), Sh. Raghbir Singh, (Technical Asstt), Sh DD Sharma, Assistant, Sh Om Prakash, (SS Staff), Sh Ashok Kumar (SS Staff), Sh Sajjan Singh, Office Asstt (Bilateral) and Sh Deen Dayal (contractual) received appreciation certificates and awards for their outstanding contribution during the year.

Exhibitions and stalls showcasing NRCE research achievements

Scientists and Staff of NRCE have participated in many exhibitions and krishifests to showcase the research activities and achievements of the institute. Staff have participated in Pusa Krishi vigyan Mela, Krishifest various other exhibitions organized by ICAR-NRCC, ICAR-CAZRI, ICAR-CSWRI, ICAR-CIAH, and Rajasthan Tourism etc., During these exhibitions the staff interacted with equine stake holders and briefed about the facilities and services being rendered by the institute.


NRCE Staff in various Exhibitions and Krishifests

NRCE Cup Race, Delhi

NRCE Cup Race held on March 25, 2019 at Delhi Race club. Dr B N Tripathi, Director NRCE was Chief Guest to the function.

Linkages Established

Linkages have been created with Agri-entrepreneurs Mr Aby Baby, Founder of Dolphin IBA, Kerala and MS Pooja Kaul, Founder of Organiko- beautifying life, New Delhi. Both the entrepreneurs are working on commercial donkey milk based products. Technical and knowledge support was provided to entrepreneurs and possibilities of collaboration for research and social development of equine farmers have been discussed. The entrepreneurs have visited NRCE to seek support for the further industry based collaborative research.


IRC, RAC, IMC and Scientific Review Meetings

Annual Institute Research Committee (IRC) Meeting

IRC meeting in progess

The annual IRC meeting of ICAR-NRCE was held on 16-17 April, 2018 under the chairmanship of Dr BN Tripathi, Director, ICAR-NRCE. A total of 38 research projects and 5 new concept notes were discussed in the meeting. Chairman suggested that scientists should come up with new hypothesis based on rigorous brain storming and more emphasis needs to be given on formulation of basic research projects. Chairman entrusted the PME Cell, ICAR-NRCE to formulate guidelines for guiding students at ICAR-NRCE. He further emphasized that the student work should be part of the approved projects or associated work approved by PME cell and a final copy of the thesis should also be submitted to NRCE Library for record. Chairman urged the scientists to publish their research papers in high impact journal. Director expressed satisfaction in the progress made by the institute during the period under report and welcomed all the suggestions from the scientists for further improvement of the research work in the institute.

Half yearly Institute Research Committee Meeting

Chairman IRC interacting with scientists of the Centre

Half yearly IRC meeting of ICAR-NRCE was held on 26 October, 2018 under the chairmanship of Director, ICAR-NRCE, Hisar. In this meeting 27 research projects from NRCE/NCVTC including 8 externally funded projects were discussed. Besides these projects, one concept note was also presented and discussed. Chairman in his opening remarks suggested that scientists should limit their role as Co-PI in 2-3 projects. It was suggested to elaborate the results while submitting IRC report to PME Cell. Finally, chairman asked all the scientists to submit research project proposal reports and monthly progress reports on time and also to upload their research publications on Krishi portal. It was also requested to submit a copy of the annual progress report of externally funded projects to PME cell for records.

22nd RAC meeting of ICAR- NRCE

The 22nd RAC meeting of ICAR- National Research Centre on Equines was held under the Chairmanship of Dr MP Yadav (Former Vice Chancellor & Director IVRI) during 11-12 February, 2019 to review the research achievements of the ongoing research projects for the year 2017-18 and to also consider new research project proposals. Dr BN Tripathi, Director ICAR-NRCE gave a brief presentation on the overall achievement of the Centre for the year 2017-18 which was followed by presentations on equine health, equine production and NCVTC. The key recommendations of the committee includes, (1) establishment of a donkey farm at the Centre, (2) evaluation of donkey milk constituents for medicinal, microbiological and nutraceutical properties, (3) assessment of the impact of disease diagnostics and technologies developed by NRCE at field level, (4) initiating the processes for achieving disease free status for Equine infectious anemia, (5) giving more emphasis on basic research and research on

bacteriophages, (6) establishment of nucleus units of Bhutia, Spiti, Kachchhi-Sindhi breeds of horses at ICAR-NRCE for their conservation, (7) regular meetings with stakeholders for popularization of equine keeping and dissemination of technologies developed by NRCE. In his concluding remarks chairman urged the scientists to work hard for the upliftment equine sector in the country and also to explore the area of value addition technology so that equine keeping will be more remunerative and attractive to the farmers.

Dr MP Yadav, Chairman RAC interacting with scientists of NRCE

Institute Management Committee (IMC) Meeting

39th meeting of the Institute Management Committee of ICAR-NRCE was held on 19th March, 2019 under the Chairmanship of Dr BN Tripathi, Director, NRCE, Hisar. Mrs Shammi Tyagi, FAO, CIRB was special invitee to the meeting. Member Secretary presented the agenda items and the following recommendations were given by the committee. (1) Engagement of AMA (Part Time Doctor) for medical treatment of employees and their dependents; (2) Repair/Repainting of first phase of NCVTC Building, (3) Re-carpeting of Roads at EPC, Bikaner; (4) Opening of Equine Clinics at NRCE, Hisar & EPC, Bikaner; (5) Establishment of a Jenny Dairy Unit (Donkey Nucleus herd), at NRCE Hisar; (6) Condemnation of old vehicles and writing off losses of damaged Library publications.

39th IMC meeting in progress

NCVTC Annual Scientific Review Meeting (2016-18)

The Eighth Annual Scientific Review meet of National Centre for Veterinary Type Cultures (NCVTC) was held at ICAR-NRCE, Hisar on 02 August, 2018. The meeting was chaired by Dr Ashok Kumar, ADG (Animal Health). Dr BN Tripathi, Director (ICAR-NRCE, Hisar) cum Project Coordinator (PC), NCVTC Hisar, informed the house about the progress in microbial collections made at NCVTC during the period 2016-18. Dr Sanjay Barua, In-charge NCVTC, Dr Sudhir Tomar, Nodal Officer (Dairy Microbe component) and Dr D Rajendran, Nodal Officer (Rumen Microbe component), presented the reports on the progress made in culture reposition. Dr BN Tripathi informed the house that NCVTC culture collection operations have now upgraded under ISO 9001-2015 system. Dr Ashok Kumar, ADG (Animal Health) emphasized the importance and uniqueness of the program that is likely to go a long way in development of one of the best repository in the country. Dr JK Jena the Deputy Director General (Animal Sciences) chaired the meeting with all the PI's/Co-PI's of the NCVTC Network in the evening on 03 August 2018. DDG emphasized that keeping in view the enormous potential of microbes for the development of biological products etc (vaccines, drugs, probiotics etc) the NCVTC needs to be strengthened in terms of infrastructure, manpower and funding. He also appreciated the quality of the publications of NCVTC scientists during recent years.

Participants of eighth annual scientific review meet of NCVTC

Visit of Dignitaries

Sh Alok Kumar Gupta visits NRCE

Sh Alok Gupta, Member Governing Body, ICAR, President, Sarabhai Foundation, Delhi, visited NRCE on May 22nd, 2018. He appraised the institute activities and said that it was his first exposure with equines and he is pleased to see the world class facilities, knowledge and laboratory equipments aiming at providing the best equine research at NRCE.

Sh. Alok Gupta visits NRCE Museum

Col Amit Kumar Rastogi applauds NRCE research activities

Col Amit Kumar Rastogi, Director Technical, RVC, IHQ of MOD visited NRCE on May 22nd, 2018. He was fascinated by the lab facilities providing extraordinary service to equine sector. He also praised the team of scientists for doing great work.

DDG Animal Sciences appreciates research activities at NRCE

Dr JK Jena, DDG (Fisheries & Animal Sciences), ICAR, New Delhi visited NRCE on August 04, 2018. He appreciated the continuous efforts of NRCE in plying a great role in serving the people of states, through providing a complete solution of equine management and health.

Vice Chancellor, TANUVAS impressed with NRCE achievements

Dr C Balachandran, Vice- Chancellor, TANUVAS visited NRCE on October 09, 2018. Dr BN Tripathi, Director, ICAR-NRCE briefed the achievements and research activities of the institute. He appreciated the efforts of NRCE to address the issues related equine stakeholders and congratulated scientists for their research attainments.

Dr Gaya Prasad, VC, SVPUAT motivates the scientists at NRCE

Dr Gaya Parshad, Vice-Chancellor, SVPUAT, Meerut visited NRCE on October 09, 2018. He had the impression of very strong infrastructure at NRCE to support research and development of broad field of equine husbandry and disease management. He appreciated the efforts of scientific manpower for raising the standards of research and development of diagnostics at the Centre.

DG, RVS appreciates the R&D activities at NRCE

Maj Gen P R Venkatesh, Director General Remount Veterinary Services & Colonel Commandant RVC, visited NRCE on November 31, 2018. He appreciated the well maintained infrastructure, laboratory facilities and excellent scientific temper coupled with outstanding diagnostic services. He appreciated the research achivements and technologies generated by the NRCE scientists and impressed with the cleanliness and greenery of the campus.

Maj Gen PR Venkatesh's visits to NRCE

Joint Secretary, DAHDF visits NRCE

Dr Upamanyu Basu JS (LH) DAHDF, GOI, MOA&FN visited NRCE on February 27, 2019 and was appraised about the research and extension activities of the Institute. He applauded the research work being carried out by the team of scientists of the institute and impressed with the technologies developed by NRCE.

Visitors from Abroad

Scientists from FLI, Germany visits NRCE

Prof Wilfred Kues, Friedrich- Loeffler Institute (FLI), Germany visited NRCE on January 4, 2019. He was Impressed with the high scientific standard of the research activities at the institute.

Dr Petersen Bjorn, Friedrich-Loeffler-Institute (FLI), Germany visited NRCE on March 03, 2019. he felt pleasure to meet the every dedicated scientific staff and various newer areas of research.

Interacting with scientists of NRCE
Prof. Wilfred Kues

Infrastructure and Development Activities

NRCE got ISO 9001:2015 certification

In an effort towards continuous quality improvement, a surveillance audit was conducted for recertification of NRCE for ISO9001:2015 certification in recognition of its Quality Management System in the area of '*Research and Development for Improving Equine Productivity, Disease Diagnosis and Microbial Conservation*'. This certificate is valid till 10 March 2020.

Certificate of Registration

Strengthening of NCVTC

During the year various developmental activities were undertaken at National Centre for Veterinary Type Cultures. The laboratory facilities were further strengthened through the construction, installation and commissioning of the Walk in Freezer/Refrigerator in the building complex. The internal and external furnishing of the 2nd and Ist phase buildings respectively is also being taken up through CPWD. Besides, the NCVTC premises were further improved with the Landscaping and horticultural development and extension of the lawns. Furthermore, several additional works viz., construction of shed for generator, fixing of new over head water tanks in the building, installation of 11 ton commercial air conditioners in the NCVTC repository were also carried out. The creation of these facilities would be useful in further strengthening the facility towards the fulfillment of its mandate.

Walk in Refrigerator/Freezer at NCVTC

Canteen facility created at NRCE, Hisar

An existing old room behind Main building was modified and renovated into a canteen hut for serving refreshments and tea for the staff working at the Centre.

Canteen Facility at NRCE

Construction of Museum and Farmers training centre at EPC, Bikaner

An Equine museum for the equine lovers and equine stakeholders is going to be ready for the next year and the works regards to construction of museum at EPC Bikaner are at their finishing stages. Adjacent to the museum, a farmers training centre is also coming and this also at the fag end stage. Both these facilities will enrich and strengthen the existing infrastructure of EPC.

Museum and Farmers Training Centre at EPC

Equine Herd Strength at Hisar Campus

	Horse		Pony		Donkey		Mule		Total
	M	F	M	F	M	F	M	F	
Stock as on 1.04.2018	2	13	0	2	3	3	1	0	**24**
Foaling	2	2	0	0	0	0	0	0	**4**
Mortality	0	2	0	1	0	0	0	0	**3**
Auction	2		0	0	1	0	1	0	**4**
Balance as on 31.03.2019	**2**	**13**	**0**	**1**	**2**	**3**	**0**	**0**	**21**

Equine Herd Strength at Equine Production Campus, Bikaner

	Horse				Pony				Donkey				Mule		Total
	Marwari		Kathiawari		Zanskari		Manipuri		Poitou		Halari				
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
Stock as on 1.04.2018	15	27	0	3	6	10	7	7	12	17	6	8	4	1	**123**
Foaling	6	6	1	1	2	2	0	1	2	2	1	1	0	0	**25**
Mortality	2	1	0	0	1	0	0	0	0	0	0	0	0	0	**4**
Balance as on 31.03.2019	**19**	**32**	**1**	**4**	**7**	**12**	**7**	**8**	**14**	**19**	**7**	**9**	**4**	**1**	**144**

Agriculture Production

During the year, 255.5 acres of land was cultivated (152.5 acre at Hisar and 103 acres at Bikaner). The land was rotationally used for cultivating green fodder, dry fodder and grains for feeding farm equines. Total farm production was 5906.60 quintals, including 3915.95 quintals of green fodder, 948.7 quintals of dry fodder and 1041.95 quintals of grains.

Summary of activities organised under MGMG

Type of crop	Production (Qtls)	
	Hisar	Bikaner
	Green Fodder	
Oats	272	909.6
Lucerne	190	685.65
Sorghum, Sudan Grass + Cowpea	432	-
Sorghum Sudan grass	201	1015.50
Sewan grass	-	210.20
Total	**1095**	**2820.95**
Dry Fodder		
Oats, Bajra, Guar, Barley, Sewan, Wheat straw etc.	435.45	513.25
Grains		
Oats	288.25	-
Gram	2.37	-
Bajra	1.73	-
Guar	-	86.00
Barley	291.60	192.00
Paddy	180.00	-
Total	**763.95**	**278.00**

Awards, Recognition and Personal Milestones

1. Dr Anju Manuja received first prize for performing Hindi work during the year 2017-2018 by ICAR- National Research centre on Equines, Hisar on 26th September, 2018 in Samapan samaroh of Hindi pakhwara.
2. Dr Anju Manuja and her team received Institute Level Outstanding Research Achievement (2017-2018) on the occasion of Independence Day 15th August, 2018.
3. Dr Anuradha Bhardwaj was Awarded OWSD full member status by The Organization for Women in Science for the Developing World (OWSD) which is an international non-profit organization based at the offices of The World Academy of Sciences (TWAS), in Trieste, Italy, a programme unit of UNESCO.

Dr. Anju and her team receiving Award from Director

4. Dr Anuradha Bhardwaj received Best Oral presentation award for her presentation on "Expression studies of recombinant equine Chorionic Gonadotropin in different host systems" in the area of proteomics and metabolomics during SVBBI National conference held at LUVAS, Hisar, Haryana in November, 2018.
5. Dr Anuradha Bhardwaj received reviewer excellence award from IJAR-ARCC two times on 15th June 2018 and 11th December, 2018.

6. Dr BR Gulati selected as Chief Editor of ISVIB journal – Veterinary Immunology & Biotechnology
7. Dr BC Bera has been selected as "Associate Member" of National Academy of Veterinary Sciences (India) for his significant contribution in veterinary sciences on 19th December, 2018
8. Dr BC Bera received appreciation for recognition of outstanding scientific contribution on the occasion of Independence Day 15th August, 2018.
9. Dr BN Tripathi, Director, NRCE has been elected as fellow of National Academy Agriculture Science (NAAS) India w.e.f. 01 January, 2019. He will be awarded the fellowship during forth coming Convocation of Academy during 4-5 June, 2019.
10. Dr Harisankar Singha received appreciation for Institute Level Outstanding Research Achievement on the occasion of Republic Day 26th January, 2019.
11. Dr Naveen Kumar and his team (Sharma S, Barua S, Tripathi BN and Rous BT) received appreciation letter from ICAR-NRCE, Hisar for publishing a review article entitled "Virological and Immunological outcomes of co-infection" in an international journal "Clinical Microbiology Reviews" having an impact factor 20.04 on the occasion of Independence Day 15th August, 2018.
12. Dr Naveen Kumar received "Elsevier Outstanding Reviewer" recognition award for reviewing a research article for "Vaccine" Journal.
13. Dr Nitin Virmani has been awarded fellowship of Indian Association of Veterinary Pathologists during the Annual Conference of Indian Association of Veterinary Pathologists organized at Department of Veterinary Pathology, C.V.Sc. & A.H., SDAU, S.K. Nagar, Gujarat during 22-24 October, 2018.

14. Dr Ramesh Kumar, PhD student working under Dr Nitin Virmani was awarded best thesis award for his work on "Pathological investigation and protective immunity of recombinant vaccine candidates of equine influenza virus in BALB/c mice" during Veterinary Pathology Congress, 2018 and XXXVth Annual Conference of Indian Association of Veterinary Pathologists organized by Department of Veterinary Pathology, C.V.Sc. & A.H., SDAU, S.K. Nagar, Gujarat during 22-24 October, 2018.

15. Dr RK Vaid has been recognized as National AMR Surveillance System (ATLASS) Assessors by FAO-USAID-The Fleming Fund-ICAR Sponsored Assessment Tool training for Laboratory Training conducted by FAO of United Nations, at CIFT, Kerala during 21-25 January, 2019.

16. Dr SC Yadav received "IAAVP Fellow Award" of the Indian Association for the Advancement of Veterinary Parasitology for the Year 2018 during 28th National Congress of Veterinary Parasitology organized at Tirupati, Andra Pradesh on 28th January 2019.

17. Dr SC Mehta has been elected as Vice-President (2019-2021) of "Society for Conservation of Domestic Animal Biodiversity" in the General Body meeting of the Society for Conservation of Domestic Animal Biodiversity (SOCDAB) held at National Bureau of Animal Genetic Resources, Karnal, Haryana on 7th February, 2018.

18. Dr TR Talluri, Sr. Scientist received "Reviewer Excellence Award" from the ARCC Journals Karnal, India.

19. Dr Taruna Anand received International "WISTEMM Indo-US fellowship" from the DST, Govt. of India and Indo-US Science and Technology Forum (IUSSTF) for a period of 3 months (03 September – 30 November, 2018) at The Rockefeller University, New York, U.S.A.

20. Dr Yash Pal and his team (Anju Manuja, Anuradha Bhardwaj, Harisankar Singha) received Certificate of appreciation award for the outstanding contribution under Mera Gaon Mera Gaurav on the occasion of Republic day 26th January, 2019.

Felicitation of Dr Nitin Virmani

Dr. SC Yadav receiving "IAAVP Fellow Award"

MGMG team being felicitated by Director, NRCE

Promotions of NRCE Staff

Sr No	Name of the staff	Discipline	Previous Designation	Promoted designation	Revised Pay level	Effective date of Promotion
Scientific staff						
1	Dr Naveen Kumar	Veterinary Microbiology	Senior Scientist	Principal Scientist	Level- 14	19.07.2017
2	Dr Harishankar Singha	Biotechnology	Scientist	Sr Scientist	Level- 12	07.01.2017
3	Dr Anuradha Bhardwaj	Biotechnology	Scientist	Sr Scientist	Level- 12	07.01.2017
4	Dr Taruna Anand	Biotechnology	Scientist	Sr Scientist	Level- 12	07.01.2017
5	Dr RK Dedar	Veterinary Medicine	Scientist	Sr Scientist	Level- 12	08.01.2017
6	Dr Prokasanand Bala	Animal Nutrition	Scientist	Sr Scientist	Level- 12	08.01.2017
7	Dr BC Bera	Biotechnology	Scientist	Sr Scientist	Level- 12	26.02.2017
8	Dr TR Talluri	Animal Gynaecology & Reproduction	Scientist	Sr Scientist	Level- 12	07.01.2018
9	Dr K Shanmugasundaram	Veterinary Pathology	Scientist	Scientist	Level- 11	07.01.2013
Technical staf						
1	Dr Jitender Singh	Veterinary Microbiology	Sr Technical Officer	Asstt Chief Technical Officer	Level -11	22.01.2016
2	Sh K S Meena	Agriculture	Sr Technical Officer	Asstt Chief Technical Officer	Level -11	19.02.2016

Transfer of NRCE Scientific Staff

Sr No	Name of the staff	Discipline	Designation	Place of New Posting	Effective date of Transfer
1.	Dr Mamta Chauhan	Animal Biochemistry	Sr. Scientist	ICAR-NDRI, Bengaluru	21.06.2018
2.	Dr Sanjay Kumar Ravi	Animal Reproduction	Scientist	ICAR-CIARI, Port Blair	07.07.2018
3.	Dr P Bala	Animal Nutrition	Scientist	ICAR-CIARI, Port Blair	09.07.2018

Superannuation of NRCE Staff

Sr No	Name of the staff	Category	Designation	Date of Superannuation
1.	Sh KK Gupta	Technical	Chief Technical Officer	31.05.2018

Publications

Research Papers

1. Anand T, Virmani N, Vaid RK, Bera B, Ahlawat U and Tripathi BN. 2018. Isolation and characterization of a bacillus phage from equine carcass disposal site. ***Defence Life Science Journal*** 4: 61-66.
2. Anand T, Bera BC, Virmani N, Vaid RK, Vashisht M and Tripathi BN. 2018. Isolation and characterization of a novel, T7 like phage against Aeromonas veronii. ***Virus Genes*** 54: 160-164.
3. Bhardwaj A, Kumar S, Nayan V, Sharma P, Pal Y and Yadav SC. 2018. Expression and characterization of recombinant single chain beta-alpha equine chorionic gonadotropin in prokaryotic host. ***Indian Journal of Animal Research***. DOI-10.18805/ijar.B-3371.
4. Choudhary BK, Choudhary M, Bera BC and Barbuddhe SB. 2018. Emergence of multi-drug resistant *Raoutella ornithinolytica* associated with Indian Major Carp. ***Current Science*** 114: 1818-1821.
5. Dedar RK, Virmani N, Bala PA, Singh J, Vaid RK, Legha RA and Tripathi BN. 2019. Clinicopathological findings of an episode of mycotoxicosis in horses. ***Equine Veterinary Education*** 31: 236-241.
6. Elschner MC, Laroucau K, Singha H, Tripathi BN, Saqib M, Gardner I, Saini S, Kumar S, El-Adawy H, Melzer F, Khan I, Malik P, Sauter-Louis C and Neubauer H. 2019. Evaluation of the comparative accuracy of the complement fixation test, Western blot and five enzyme-linked immunosorbent assays for serodiagnosis of glanders. ***PLoS ONE.*** 14(4): e0214963. https://doi.org/10.1371/journal. pone.0214963
7. Gupta AK, Kumar S, Pal Y, Bhardwaj, A, Mamta Chauhan, Birendra Kumar, Prince and Vijh RK. 2018. Genetic diversity and structure analysis of donkey population clusters in different indian agro-climatic regions. ***J Biodivers Endanger Species*** 2018. 6:S2. DOI: 10.4172/2332-2543.S2225.
8. Kumar B, Manuja A, Gulati BR, Virmani N and Tripathi BN. 2018. Zoonotic viral diseases of equines and their impact on human and animal health. ***The Open Virology Journal*** 12:80.
9. Kumar N, Khandelwal, N, Riyesh T, Chaubey KK, Sharma S, Rawat KD, Singh SV, Tripath BN and Barua S. 2019. Inhibitor of sarco/endoplasmic reticulum calcium-atpase impairs multiple steps of paramyxovirus replication. ***Frontiers in Microbiology***. DOI: 10.3389/fmicb.2019.00209.
10. Kumar N, Sharma S, Barua S, Tripathi BN and Rouse BT. 2018. Virological and Immunological outcomes of coinfections. ***Clinical Microbiology Reviews*** 31: e0011-17.
11. Kumar R, Khandelwal, N, Riyesh T, Tripath BN, Maherchandani S, Kashyap SK, Barua S and Kumar N. 2018. Role of MAPK/MNK1 pathway in virus replication. ***Virus Research*** 253: 48-61.
12. Kumar R, Khandelwal, N, Riyesh T, Tripathi BN, Maherchandani S, Kashyap SK, Barua S and Kumar N. 2018. MNK1 inhibitor as an antiviral agent suppresses buffalopox virus replication. ***Antiviral Research*** 160, 126-136.
13. Kumar R, Sarkhel SP, Kumar S, Kanisht B, Sethi K, Shikha J, Kumar S and Tripathi BN 2019. Molecular characterization and phylogenetic analysis of Trypanosoma evansi from Northern India based on 18S ribosomal gene Veterinary Parasitology. ***Regional Studies and Reports***. https://doi.org/10.1016/j.vprsr.2018.100259.
14. Kumar R, Neeraj Dilbaghi, Sandeep Kumar, Gupta AK, Prabhat Kumar, Khurana SK and Yadav SC. 2018. Development and evaluation of lateral flow assay for point of care diagnosis of Trypanosomosis in equines. ***Journal of Equine Veterinary Sciences***. 10.1016/j.jevs.2018.07.007.
15. Legha RA, Kumar V, Pal Y, Dedar RK, Bala PA, Ravi SK, TR Talluri and Tripathi BN. 2018. Physiological,

Hematological and Biochemical Indices in Non-Descript Indian Donkeys Working With Different Pack Loads in Brick Kiln Simulated Conditions. ***International Journal Livestock Research***. eISSN: 2277-1964. 8: 6.

16. Maji C, Goel P, Suthar A, Kruti D, Gopalakrishnan Kumar R, Tripathi BN and Kumar S. 2019. Lumefantrine and o-choline – Parasite metabolism specific drug molecules inhibited in vitro growth of Theileriaequi and Babesia caballi in MASP culture system. ***Ticks and Tick-borne Diseases***. https://doi.org/10.1016/j.ttbdis.2019.01.004.
17. Manuja A and Kumar B. 2018. Therapeutics against Trypanosomiasis. ***Current Topics in Medicinal Chemistry*** 18:25: 2138-2140
18. Manuja A, Dilbaghi N, Kaur H, Saini R, Barnela M, Chopra M, Manuja BK, Kumar, Sandeep Kumar R, Riyesh T, Singh SK and Yadav SC. 2018. Chitosan quinapyramine sulfate nanoparticles exhibit increased trypanocidal activity in mice. ***Nano-Structures & Nano-Objects*** 16: 193-199.
19. Manuja A, Kumar B, Kumar R, Chopra M, Dilbaghi N, Kumar S and Yadav SC. 2018. Encapsulated quinapyramine sulfate-loaded chitosan/mannitol nanoparticles: biocompatibility and targeting efficiency in rabbit model of trypanosomosis. ***Antimicrobial Agents & Chemotherapy***. http//doi.org/10:1128/AAC.00460-18.
20. Manuja A, Kumar B, Singha H. 2019. Sequence and functional variability of Toll-like receptor 9 gene in equines. ***Molecular Immunology*** 105: 276-282.
21. Nayak TC, Dedar RK, Chahar A and Savita. 2018. Studies on prevalence and risk associated factors of enteric salmonella (Inva gene) in horses in Bikaner. ***Veterinary Practitioner*** 19: 87-89.
22. Parashar R, Singla LD, Kanisht B, Kumar R, Kashyap N, Kaur P and Bal MS. 2018. Unraveling cryptic epizootiology of equid trypanosomosis in Punjab state of India by parasitological and sero-molecular techniques. ***Acta Tropica*** 185: 18-26.
23. Pegu SR, Choudhury M, Rajkhowa S, Sarma DK and Gulati BR. 2019. Molecular characterization and pathological studies of Japanese encephalitis virus in pigs of Assam. ***International Journal of Entomology and Zoology Studies*** 7: 874-878.
24. Rathore NS, Kashyap SK, Anupama Deora, Pankaj Kumar, Singh J, Tripathi BN and Talluri TR. 2018. Comparative study of different protocols for isolation of putative mesenchymal stem cells from equine umbilical cord wharton's jelly. ***Indian Journal of Animal Sciences*** 88: 1025–1029
25. Saini S, Singha H, Siwach P and Tripathi BN. 2019. Recombinant horse IL-4 and IL-10 induced a mixed inflammatory cytokine response in horse peripheral blood mononuclear cells (PBMCs). ***Veterinary World*** 12: 496-503
26. Sarmah PC, Kakati P, Bhattacharjee PK, Prabhat Kumar and Yadav SC. 2018. Evaluation of Formol Gel Slide Test with reference to Blood Microscopy and Enzyme Linked Immunosorbant Assay for diagnosis of surra in cattle. ***Journal of Experimental Biology and Agricultural Sciences*** 6: 437-442.
27. Shanmugasundaram K and Tripathi BN. 2018. Johne's Disease Vaccines Past, Present and Future. ***Advances in Biotechnology & Microbiology*** 10(2): DOI: 10.19080/AIBM.2018.10.555784.
28. Singh RK, Dhama Kuldeep, Kumaragurubaran Karthik, Khandia Rekha, Munjal Ashok, Khurana SK, Chakraborty Sandip, Malik Yashpal S, Virmani Nitin, Singh Rajendra, Tripathi BN, Munir Muhammad and Vander Kolk Johannes. 2018. A Comprehensive Review on Equine Influenza Virus: Etiology, Epidemiology, Pathobiology, Advances in Developing Diagnostics, Vaccines, and Control Strategies. ***Frontiers in Microbiology***. https://doi.org/10.3389/fmicb.2018.01941.
29. Singh S, Dohre SK, Kamthan A, Pal V, Karothia BS, Singha H and Kumar S. 2018. Improvement of recombinant-truncated Burkholderia motility protein A (BimA)-based indirect ELISA for equine glanders.

Journal of Immunoassay & Immunochemistry 39: 565-575.

30. Songara M, Arun Kumar Jhirwal, Subhash Chander Goswami, Legha RA, Vijay Kumar, Vikramjit Singh and Geetesh Mishra. 2018. Growth and digestibility of gross nutrients by azolla incorporation in Marwari stallion. ***International Journal of Chemical Studies***. 6:5: 3215-3218.
31. Soni Y, Talluri TR, Ashok Kumar, Ravi SK, Mehta JS and Tripathi BN. 2018. Effects of different concentration and combinations of cryoprotectants on sperm quality, functional integrity in three Indian horse breeds. ***Cryobiology***. https://doi.org/10.1016/j.cryobiol.2018.12.005
32. Talluri TR, Ravi SK, Singh C, Legha RA, Mehta SC, Prakash V and Tripathi BN. 2019. Effect of two different permeable cryoprotectants on freezability of exotic stallion and jack semen. ***Indian Journal of Animal Reproduction*** 40: 27-30.
33. Vaid RK, Shanmugasundaram K, Anand T, Bera BC, Tigga Mamta, Dedar RK, Riyesh T, Bardwaj Shashank, Virmani Nitin, Tripathi BN and Singh RK. 2018. Characterization of isolates of *Bordetella bronchiseptica* from horses. ***Journal of Equine Science*** 29: 25–31.

ABSTRACTS PUBLISHED IN CONFERENCES/ SYMPOSIA

1. Bhardwaj A, Varij Nayan, Neha Chakarvarty, Sudarshan Kumar, Sanjay Kumar, Yash Pal and Yadav SC. 2018. Expression studies of recombinant equine Chorionic Gonadotropin in different host. Third Convention of Society of Veterinary Biochemists and Biotechnologists of India (SVBBI 2018) and National Symposium on "Bridging Biochemical Interventions and Environmental Remediations for One Health Improvement" held at LUVAS, Hisar, Haryana during 2-3 November.
2. Bhardwaj A, Yash Pal, Mehta SC and Tripathi BN. 2019. Studies on major morphometric parameters of Kachchhi-Sindhi horses. XVI Annual Convention of Society for Conservation of Domestic Animal Biodiversity (SOCDAB) and National Symposium on "Animal Genetic Resources for Food and Social Security" held at NBAGR, Karnal, Haryana during 7-8 February.
3. Chauhan M, Anuradha Bhardwaj, Yash Pal, Gupta AK and Tripathi BN. 2019. Microsatellite markers based parentage verification in indigenous equine population. In XVI Annual Convention of Society for Conservation of Domestic Animal Biodiversity (SOCDAB) and National Symposium on "Sustainable Management of Livestock and Poultry Diversity for enhancing the Farmers' Income" at NBAGR, Karnal, Haryana, during 7-8 February.
4. Dedar RK, Singh J and Tripathi BN. 2019. Hypophosphatemia in equines. In 37th Annual Convention of Indian Society for Veterinary Medicine organized by Department of Clinical Veterinary Medicine, Ethics and Jurisprudence College of Veterinary and Animal Science, Bikaner RAJUVAS, Bikaner, Rajasthan during 1-3 February.
5. Kumar N, Thachamvally Riyesh, Nitin Khandelwal, Krishan Dutt Rawat, Tripathi BN and Sanjay Barua. 2018. Inhibitor of sarco/endoplasmic reticulum calcium-ATPase impairs paramyxovirus replication". In, Book of Abstracts of Second International Conference on Contemporary Antimicrobial Research, organized by IIT Kharagpur in collaboration with Society for Antimicrobial Research during 15-17 December.
6. Kumar P, Mehta JS, Ravi SK, Talluri T Rao, Purohit GN, Ashok Kumar, Dholpuria S and Amit Kumar. 2018. Cholesterol loaded cyclodextrin increases cryopreservability of Marwari stallion spermatozoa by increasing cholesterol to phospholipid ratio. International Symposium on "Productivity Enhancement through Augmenting Reproductive Efficiency of Livestock for Sustainable Rural Economy" and 34th Convention of ISSAR held at College of Veterinary Science and Animal Husbandry, Anand, Gujarat during 28-30 December.
7. Kumar R, Nitin Khandelwal, Yogesh Chander, Thachamvally Riyesh, Tripathi BN, Sanjay Barua, Sunil Maherchandani and Naveen Kumar. 2018. MNK1 inhibitor as an antiviral agent suppresses buffalopox virus

protein synthesis. In, Second international conference on contemporary antimicrobial research, organized by IIT Kharagpur in collaboration with Society for Antimicrobial research during 15-17 December.

8. Kumar R, Kumar Saroj, Batra K, Sethi K, Rani Ruma, Kumar S and Tripathi BN. 2019. Molecular cloning and characterization of Invariant Surface Glycoprotein, 65kDa (ISG65) for diagnosis of Surra in animals. In Proceedings of 28thNational Congress of Veterinary Parasitology organized by Department of Veterinary Parasitology, College of Veterinary Science, SVVU, Tirupati during 28-30 January.
9. Legha RA, Yash Pal, Talluri TR, Dedar RK and Tripathi BN. 2019. Pulling capacity of Halari donkeys in pneumatic two-wheel cart. In XVI National Symposium on Animal Genetic Resources for Food and Social Security at ICAR-NBAGR Karnal during 7-8 February.
10. Manuja A and Kumar B. 2018. Zinc oxide nanopaticles "Potential and safety issues in tissue repair" In Proc. Seventh International Symposium on Regenerative Rehabilitation held at Seattle, Washington, USA during 11-13 October.
11. Pal Y, Sanjay Kumar, Legha RA, Anuradha Bhardwaj and Tripathi BN. 2019. Composition of milk of Manipuri pony in arid conditions. XVI Annual Convention of Society for Conservation of Domestic Animal Biodiversity (SOCDAB) and National Symposium on "Sustainable Management of Livestock and Poultry Diversity for enhancing the Farmers' Income" at NBAGR, Karnal, Haryana during 7-8 February.
12. Paul BR, Mandal KD, Maji C, Chauhan S, Tripathi BN, Kumar R and Kumar S. 2019. Repurposing of target specific drug molecules against asexual stages of *Theileriaequi* in MASP *in vitro* culture. Proceedings, 28thNational Congress of Veterinary Parasitology organized by Department of Veterinary Parasitology, College of Veterinary Science, SVVU, Tirupati during 28-30 January.
13. Rathore NS, Kashyap SK, Anupama Deora, Pankaj Kumar, Singh J, Tripathi BN and Talluri TR. 2018. Isolation, culture and characterization of mesenchymal stem cells from fetal adnexa in equines. International Symposium on "Productivity Enhancement through Augmenting Reproductive Efficiency of Livestock for Sustainable Rural Economy" and 34th Convention of ISSAR held at College of Veterinary Science and Animal Husbandry, Anand, Gujarat during 28-30 December.
14. Riyesh T , Chander Y, Panigrahi S , Kumar R, Khandelwal N, Shanmugasundaram K, Jindal N, Kumar N, Barua S and Tripathi BN. 2018. Complete genome analysis of chicken astroviruses isolated from poultry. In "INTERVIROCON 2018", International Conference organized by PGIMER, Chandigarh, India during 12-14 November.
15. Saini Sheetal, Singha Harisankar, Siwach Priyanka and Tripathi BN. 2018. Molecular cloning and phylogenetic analysis of Indian Marwari Horse cytokines: Interleukin (IL)-6, IL-17, Tumor necrosis factor alpha (TNF-α) and Interferon gamma (IFN-γ). In: 3rd Convention of Society of Veterinary Biochemists and Biotechnologists of India and National Symposium on Bridging Biochemical Interventions and Environmental Remediations for One Health Improvement (SVBBI 2018) organized by LUVAS, Hisar during 2-3 November.
16. Saini Sheetal, Singha Harisankar, Siwach Priyanka and Tripathi BN. 2018. Expression of equine interleukin (IL)-2, IL-4, IL-10, IL-18, IFN-γ in Baculovirus expression system. In 5th European Congress of Immunology 2018 in Amsterdam, Netherlands during 2-5 September.
17. Singha H, Shanmugasundaram K, Khurana SK, Tripathi BN. 2019. Surveillance of equines and in-contact humans in India for Glanders -a zoonotic and notifiable equine disease. In: One Health India Conference held at New Delhi during 18-19 February.
18. Singha H, Sheetal Saini and Tripathi BN. 2018. Glanders-a zoonotic and notifiable equine disease: One health perspectives. In 3rd Convention of Society of Veterinary Biochemists and Biotechnologists of India and National Symposium on Bridging Biochemical Interventions and Environmental Remediations for One Health Improvement (SVBBI 2018) Organized by LUVAS, Hisar during 2-3 November.

19. Songara M, Legha RA, Arun Kumar Jhirwal, Goswami SC, Choudhary VK, Thirumala Rao Talluri and Yash Pal. 2018. Effect of feeding azolla on libido and seminal parameters in Marwari stallions. International Symposium on "Productivity Enhancement through Augmenting Reproductive Efficiency of Livestock for Sustainable Rural Economy" and 34th Convention of ISSAR held at College of Veterinary Science and Animal Husbandry, Anand, Gujarat during 28-30 December.

20. Talluri TR, Chandan Singh, legha RA, Yash Pal, Ved Prakash and Tripathi BN. 2019. Comparative study of growth patterns of foals from foal heat breeding and subsequent estrus breeding. XVI National Symposium on Animal Genetic Resources for Food and Social Security at ICAR-NBAGR Karnal during 7-8 February.

21. Talluri TR, Selokar NL, Sharma Papori, Kumar D, Ravi SK and Tripathi BN. 2018. Effect of type of donor cell and amount of cytoplasm in generation of *i*scnt embryos through handmade cloning (HMC). International Symposium on "Productivity Enhancement through Augmenting Reproductive Efficiency of Livestock for Sustainable Rural Economy" and 34th Convention of ISSAR held at College of Veterinary Science and Animal Husbandry, Anand, Gujarat during 28-30 December.

22. Talluri TR, Ravi SK, Legha RA and Tripathi BN. 2018. Comparative morphometric analysis of spermatozoa of three indigenous stallion breeds. International Symposium on "Productivity Enhancement through Augmenting Reproductive Efficiency of Livestock for Sustainable Rural Economy" and 34th Convention of ISSAR held at College of Veterinary Science and Animal Husbandry, Anand, Gujarat during 28-30 December.

23. Talluri TR. 2018. Prospects and challenges of application of ARTs in Equines - Indian Scenario. International Symposium on "Productivity Enhancement through Augmenting Reproductive Efficiency of Livestock for Sustainable Rural Economy" and 34th Convention of ISSAR held at College of Veterinary Science and Animal Husbandry, Anand, Gujarat during 28-30 December.

24. Tripathi BN, Sinhga HS and Shanmugasundaram K. 2018. Epidemiology, pathogenesis and control of Glanders in India. 2018. In Veterinary Pathology Congress, National Symposium on Recent advances in Veterinary pathology and disease diagnosis for sustainable livestock and poultry production held at College of Veterinary Science and AH, Sardarkrushinagar Dantiwada Agricultural University, Gujarat during 22-24 October.

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26. Vaid RK, Sharma Tanisha, Batra Priyanka, Taruna Anand, Bardwaj Shashank, Shanmugasundaram K, Kumar Naveen, Kumar Balwinder, Thachamvally Riyesh, Thakur Sidharth Dev and Tripathi BN. 2019. Outbreak of mastitis in buffalo and cattle herds and detection of methicillin resistant *Staphylococcus aureus* and ESBL-producing Gram-negative bacilli, in the XIV Agricultural Science Congress during 20-23 February.

27. Nayan Varij and Bhardwaj Anuradha. 2018. In-Silico Pharmacology, Antimicrobial Peptide and Immunoreagent Design for Animal Production and Health: Current Contexts and Future Implications. Third Convention of Society of Veterinary Biochemists and Biotechnologists of India (SVBBI 2018) and National Symposium on "Bridging Biochemical Interventions and Environmental Remediations for One Health Improvement" held at LUVAS, Hisar, Haryana during 2-3 November.

28. Nayan Varij, Bhardwaj Anuradha, Onteru SK and Singh Dheer. 2019. In Silico Pharmacology and Computational Immunoreagent Design Quests towards Timing A.I. and Early Pregnancy Identification in Buffalo. XVI Annual Convention of Society for Conservation of Domestic Animal Biodiversity (SOCDAB) and National Symposium on "Sustainable Management of Livestock and Poultry Diversity for enhancing the

Farmers' Income" at NBAGR, Karnal, Haryana during 6-7 February.

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30. Virmani N, Pavulraj S, Sansanwal Rekha, Anand Taruna, Bera BC, Ahlawat Umang, Gulati BR, Singh BK, Singh RK and Tripathi BN. 2018. Protective efficacy of eukaryotically expressed recombinant glycoproteins (gB, gD and gM) against EHV1 infection in murine model. Veterinary Pathology Congress, 2018 and XXXVth Annual Conference of Indian Association of Veterinary Pathologists, IX Annual Meeting of Indian College of Veterinary Pathologists and National Symposium on "Recent Advances in Veterinary Pathology and Disease Diagnosis for Sustainable Livestock and Poultry Production" Organized by Department of Veterinary Pathology, C.V.Sc. & A.H., SDAU, S.K. Nagar, Gujarat during 22-24 October.
31. Virmani N and BN Tripathi. 2019. Collection, preservation and dispatch of material for disease diagnosis in Symposium on Advances in equine health and management held at ICAR-National Research Centre on Equines, Hisar, Haryana on 27 February.
32. Virmani N, Gulati BR, Adya Prakash Rath, Bera BC, Taruna Anand, Tanvi Bhatia, Rekha Sansanwal, Karthik S, Venkataramireddy Balena, Manu Mathew, Ramesh Kumar, Rakesh Kumar and Tripathi BN. 2018. Comparative immunogenicity and protective efficacy of inactivated EHV1 vaccine employing various adjuvants in murine model in XXV Annual Convention and National Conference on Innovative Biotechnological Approaches for Improving Animal Health and Productivity VIBCON-2018 held at ICAR-NRC on Mithun, Medziphema, Nagaland during 13-15 December.

BOOKS

1. Tripathi BN, Kumar N and Barua S. 2018. Peste des petits ruminants: Sheep and Goat Plague, ISBN 81-709-618-6, Today and Tomorrow's Printers and Publishers, Pp 1-180.
2. Dedar RK, Tripathi BN, Singh AP, Ravi SK, Yash Pal, Legha RA and Sanjay Kumar. 2018. Handbook of equine practitioners. Narender Publishing House, New Delhi, ISBN no. 9789386110664.

BOOK CHAPTERS, E-PUBLICATIONS, TECHNICAL BULLETINS, POPULAR ARTICLES

1. Bhardwaj A, Yash Pal and BN Tripathi. 2019. Parentage verification in equines through genomic markers. *Equipedia*, NRCE.
2. Gulati BR, Virmani N, Yadav SC, Singha HS, Kumar R, Kumar S and Tripathi BN. 2019. Diagnosis and control of important infectious diseases in India. Proceedings IAVMI One Day Symposium on 'Advances in Equine Health & Management'.
3. Gulati BR. 2018. Production and characterization of equine mesenchymal stem cells. 32nd ICAR-CAFT Course in Veterinary Microbiology on 'Recent Advances in Cell based Technologies for Animal Disease Diagnostics and Therapeutics' held at Department of Veterinary Microbiology, LUVAS, Hisar.
4. Gulati BR. 2018. Virus neutralization test for diagnosis of Equine Herpes Virus-1 infection. 32nd ICAR-CAFT Course in Veterinary Microbiology on 'Recent Advances in Cell based Technologies for Animal Disease Diagnostics and Therapeutics' at Department of Veterinary Microbiology, LUVAS, Hisar.
5. Legha RA, Talluri TR and Yash Pal. 2018. Fodders in Equine Nutrition: issues and Solution. Perspective in Animal Nutrition in compendium of XI Biennial conference of ANACON being organized at Patna (Bihar) during 19-21 November.
6. Manuja A, Kumar Naveen, Bhardwaj A, Riyesh T and Kumar B. 2019. Advances in Equine Health &

Management. (NRCE Publication)

7. Manuja A, Tripathi H, Kumar R and Tripathi BN. 2019. Equine Health and Production Management. (NRCE Publication)
8. Manuja A, Tripathi H, Kumar R, Tripathi BN. 2019. अश्व स्वास्थ्य एवं प्रबंधन: सामान्य जानकारी (NRCE Publication)
9. Manuja Aand Kumar Balvinder. 2019. Metabolic/non-Infectious Diseases of Equines and their Management. Proceedings IAVMI One Day Symposium on 'Advances in Equine Health & Management.
10. Nayan V and Bhardwaj A. 2018. Agri-Entrepreneurship development through Bovines. In book on Agri-entrepreneurship development through farming system approach. pp 153-164.
11. Nayan V, Bhardwaj A, Lyngdoh EL, Bhatia T, Pawaria S and Jasmer. 2019. Clinical applications of reproductive hormones in animals. In Buffalo production and performance recording techniques. Published by ICAR-CIRB, Hisar.
12. Pal Y. 2018. "Pregnancy Diagnosis in Mares" in proceedings of National symposium and XXVII Annual conference of Society of Animal Physiologists of India held on "Augmentation of animal productivity under changing socio-economic scenario" held at NDRI, Karnal.
13. Pal Y, Sharma P, Bhardwaj A, Legha RA and Tripathi BN. 2018. Agri-Entrepreneurship development through Equines. In book on Agri-entrepreneurship development through farming system approach.
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3. Anand T, Ahlawat U, Virmani N, Bera BC, Vaid RK, Singh, M, Mittal D, Tripathi BN 2018. Staphylococcus haemolyticus strain FOP210 partial 16srRNA. Genbank: MH393460.

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5. Anand T, Ahlawat U, Virmani N, Bera BC, Vaid RK, Singh, M, Mittal D, Tripathi BN 2018. Staphylococcus haemolyticus strain FOP216 partial 16srRNA. Genbank: MH393493.
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7. Anand T, Ahlawat U, Virmani N, Bera BC, Vaid RK, Singh, M, Mittal D, Tripathi BN 2018. Staphylococcus sciuri strain FOP219 partial 16srRNA. Genbank: MH393495.
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9. Anand T, Ahlawat, U, Virmani N, Bera BC, Vaid RK, Singh, M, Mittal D, Tripathi, BN. 2018. Staphylococcus sp. strain FOP222 partial 16srRNA. Genbank: MH393497
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11. Anand T, Ahlawat U, Virmani N, Bera BC, Vaid RK, Singh M, Mittal D, Tripathi, BN. 2018. Klebsiella pneumoniae strain FOP225 partial 16srRNA. Genbank: MH393501
12. Anand T, Ahlawat U, Virmani N, Bera BC, Vaid RK, Singh M, Mittal D, Tripathi BN. 2018. Streptococcus dysgalactiae strain FOP177 partial 16srRNA. Genbank: MH393507.
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15. Anand T, Ahlawat U, Virmani N, Bera BC, Vaid RK, Singh, M, Mittal D, Tripathi, BN. 2018. Staphylococcus haemolyticus strain FOP194 partial 16srRNA. Genbank: MH393509.
16. Anand T, Ahlawat U, Virmani N, Bera BC, Vaid RK, Singh, M, Mittal D, Tripathi, BN. 2018. Staphylococcus sciuri strain FOP198 partial 16srRNA. Genbank: MH393511.
17. Anand T, Ahlawat U, Virmani N, Bera BC, Vaid RK, Singh, M, Mittal D, Tripathi, BN. 2018. Staphylococcus sp. strain FOP171A partial 16srRNA. Genbank: MH393512.
18. Anand T, Ahlawat U, Virmani N, Bera BC, Vaid RK, Singh, M, Mittal D, Tripathi, BN. 2018. Micrococcus lylae strain FOP172B partial 16srRNA. Genbank: MH393514.
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27. Bera BC, Anand T, Virmani N, Karthik S and Tripathi BN. 2018. Influenza A virus (A/swine/Mizoram/mzH6/2017(H1N1)) segment 2 polymerase PB1 (PB1) gene, complete cds; and nonfunctional PB1-F2 protein (PB1-F2) gene, complete sequence.. GenBank: MK680244.
28. Bera BC, Anand T, Virmani N, Karthik S and Tripathi BN. 2018. Influenza A virus (A/swine/Mizoram/mzH6/2017(H1N1)) segment 3 polymerase PA (PA) and PA-X protein (PA-X) genes, complete cds. GenBank: MK680245.
29. Bera BC, Anand T, Virmani N, Karthik S and Tripathi BN. 2018. Influenza A virus (A/swine/Mizoram/mzH6/2017(H1N1)) segment 4 hemagglutinin (HA) gene, complete cds. GenBank: MK680246.
30. Bera BC, Anand T, Virmani N, Karthik S and Tripathi BN. 2018. Influenza A virus (A/swine/Mizoram/mzH6/2017(H1N1)) segment 5 nucleocapsid protein (NP) gene, complete cds. GenBank: MK680247.
31. Bera BC, Anand T, Virmani N, Karthik,S. and Tripathi BN. 2018. Influenza A virus (A/swine/Mizoram/mzH6/2017(H1N1)) segment 6 neuraminidase (NA) gene, complete cds. GenBank: MK680248.
32. Bera BC, Anand T, Virmani N, Karthik S and Tripathi BN. 2018. Influenza A virus (A/swine/Mizoram/mzH6/2017(H1N1)) segment 7 matrix protein 2 (M2) and matrix protein 1 (M1) genes, complete cds. 2018. GenBank: MK680249.
33. Bera BC, Anand T, Virmani N, Karthik S and Tripathi BN. 2018. Influenza A virus (A/swine/Mizoram/mzH6/2017(H1N1)) segment 8 nuclear export protein (NEP) and nonstructural protein 1 (NS1) genes, complete cds.2018. GenBank: MK680250.
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35. Panigrahi S, Kumar P, Jindal N, Barua S, Kumar N, Riyesh T and Chander Y. 2018. Avian nephritis virus strain CAstV/G9/14/HR-Ind/Chicken RNA-dependent RNA polymerase gene, partial cds. 384 bp linear RNA MF380439.1
36. Panigrahi S, Kumar P, Jindal N, Barua S, Kumar N, Riyesh T and Chander Y. 2018. Avian nephritis virus strain CAstV/G3/15/HR-Ind/Chicken RNA-dependent RNA polymerase gene, partial cds 384 bp linear RNA MF380438.1
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Participation, Presentation in Seminars, Conferences & Symposia

1. Anju Manuja participated in Seventh International Symposium on Regenerative Rehabilitation held at Seattle , Washington, USA during 11-13 October, 2018,
2. Anju Manuja participated in a National workshop on regulatory compliance for accelerating innovations" organized by Biotechnology Industry Research Assistance Council (BIRAC) at NCL innovations park, Pune Maharashtra on February 8, 2019.
3. Anju Manuja participated in one day Symposium of Indian Association of Veterinary Microbiologists, Immunologists and Specialists in Infectious Diseases (IAVMI) on 'Advances in Equine Health & Management' organized at ICAR-National Research Centre on Equines, Hisar on February 27, 2019.
4. Anuradha Bhardwaj attended a National Brainstorming Workshop on NADS(I) at CIRB, Hisar on 20 July, 2018.
5. Balvinder Kumar attended a National Brainstorming workshop of NADS(I) CIRB Hisar on 20 July, 2018.
6. Balvinder Kumar attended one day Symposium of Indian Association of Veterinary Microbiologists, Immunologists and Specialists in Infectious Diseases (IAVMI) on 'Advances in Equine Health & Management' organized at ICAR-National Research Centre on Equines, Hisar on 27 February, 2019.
7. Bera BC attended one day Symposium of Indian Association of Veterinary Microbiologists, Immunologists and Specialists in Infectious Diseases (IAVMI) on 'Advances in Equine Health & Management' organized at ICAR-National Research Centre on Equines, Hisar on February 27, 2019.
8. Gulati BR participated in 27th International Conference of Virology of Indian Virological Society (Intervirocon-2018) organized at PGIMER, Chandigarh during November 12-14, 2018.
9. Gulati BR participated in XXV Annual Convention of Indian Society of Veterinary Immunology and Biotechnology (VIBCON-2018) & National Symposium on "Innovative Biotechnological Approaches for Improving Animal Health and Productivity" at ICAR-National Research Centre on Mithun, Medziphema, Dimapur, Nagaland during December 13-15, 2018.
10. Gulati BR participated in One Day Symposium of Indian Association of Veterinary Microbiologists, Immunologists and Specialists in Infectious Diseases (IAVMI) on 'Advances in Equine Health & Management' organized at ICAR-National Research Centre on Equines, Hisar on February 27, 2019.
11. Legha RA participated in an international Symposium on "Productivity Enhancement through Augmenting Reproductive Efficiency of Livestock for Sustainable Rural Economy" and 34th Convention of ISSAR held at College of Veterinary Science and Animal Husbandry, Anand, Gujarat during December 28-30, 2018.
12. Legha RA participated in XVI Annual Convention of Society for Conservation of Domestic Animal Biodiversity (SOCDAB) and National Symposium on "Sustainable Management of Livestock and Poultry

Diversity for enhancing the Farmers' Income" at ICAR-NBAGR, Karnal, Haryana during February 6-7, 2019.

13. Legha RA participated in one day Symposium of Indian Association of Veterinary Microbiologists, Immunologists and Specialists in Infectious Diseases (IAVMI) on 'Advances in Equine Health & Management' organized at ICAR-National Research Centre on Equines, Hisar on February 27, 2019.
14. Mehta SC delivered an invited lecture on Present Status of Equine Genetic Resources in India. In: Summer School on Conservation of Indigenous Livestock Germplasm: An AVANT-GARDE approach to success, organized by the Department of Animal Genetics & Breeding, Madras Veterinary College, Chennai during May 2-22, 2018.
15. Mehta SC participated in Breed Registration Committee Meeting at ICAR Headquarter, New Delhi on September 05, 2018.
16. Mehta SC participated in a Workshop on "Status and Strategies for Enhancing Crop Water Productivity in IGNP Area" organized by ICAR-CAZRI, RRS, Bikaner on November 14, 2018.
17. Mehta SC participated in a Workshop on "Issue of earliest characterization of our animal genetic resources" organized by ICAR-National Bureau of Animal Genetic Resources, Karnal at NASC Complex, ICAR, New Delhi on December 03, 2018.
18. Mehta SC participated in National Symposium on Animal Genetic Resources for Food and Social Security Organized by the Society for Conservation of Domestic Animal Biodiversity and National Bureau of Animal Genetic Resources, Karnal at Karnal, Haryana during February 7-8, 2019.
19. Naveen Kumar participated in Second international conference on contemporary antimicrobial research, organized by IIT Kharagpur in collaboration with Society for Antimicrobial research at IIT Kharagpur during December 15-17, 2018.
20. Riyesh T participated and presented regional coordinators report in "National multi-stakeholder workshop for strengthening inter-sectoral coordination for prevention and control of zoonotic diseases" organized by National Centre for Disease Control at New Delhi during February 27-28, 2019.
21. Singha HS participated in BIRAC innovators conclave and Bio-innovation fair organized by Biotechnology Research Assistance Council (BIRAC), DBT, Govt of India at Heritage Village Resort, Manesar during September 19-20, 2018.
22. Singha HS participated in 3rd Convention of Society of Veterinary Biochemists and Biotechnologists of India and National Symposium on Bridging Biochemical Interventions and Environmental Remediation's for One Health Improvement (SVBBI 2018), organized by LUVAS, Hisar during November 2-3, 2018.
23. Singha HS participated in a Workshop on 'National animal disease control programme and important emerging diseases of livestock' organized by Animal Husbandry Department, Govt of Madhya Pradesh at Bhopal on February 14, 2019.
24. Singha HS participated in One Health India Conference 2019 Convened by Department of Biotechnology (DBT), Ministry of Science & Technology, SCOPE Complex, Lodhi Road, New Delhi during February 18-19, 2019.
25. Singha HS participated in One Day Symposium on Advances in Equine Health and Management

organized by ICAR-NRCE and IAVMI on February 27, 2019.

26. Talluri TR participated in an international Symposium on "Productivity Enhancement through Augmenting Reproductive Efficiency of Livestock for Sustainable Rural Economy" and 34th Convention of ISSAR held at College of Veterinary Science and Animal Husbandry, Anand, Gujarat from December 28-30, 2018.

27. Talluri TR participated one day Symposium of Indian Association of Veterinary Microbiologists, Immunologists and Specialists in Infectious Diseases (IAVMI) on 'Advances in Equine Health & Management' organized at ICAR-National Research Centre on Equines, Hisar on February 27, 2019.

28. Tripathi BN and HS Singha presented a topic on "Diagnosis, control and eradication of equine Glanders with special reference to Uttar Pradesh" in one day workshop on "Surveillance of Glanders & Farci" on the occasion of world Zoonosis Day organized by Directorate, Animal Husbandry Department, Lucknow, Uttar Pradesh on July 06, 2018.

29. Tripathi BN delivered a lecture on "National Glanders Erodication Programme (NGEP)" in the meeting on National Programme for elimination of Foot and Mouth, Glanders disease infestations from India held at NITI Aayog under the Chairmanship of member (Agri), NITI Aayog, New Delhi on July 13, 2018.

30. Tripathi BN attended the XXXV Annual Conference of Indian Association of Veterinary Pathologist (IAVP) as a special invitee and delivered an Expertise IAVP-CVPE Key Note Address on "Epidemiology, Pathogenesis and Control of Glanders in India", organized by the Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat during October 22-24, 2018.

31. Tripathi BN attended an interactive workshop to discuss the Animal Genetic Resource issues with all the stakeholders, organized by Indian Council of Agricultural Research at NASC Complex, New Delhi on December 3, 2018.

32. Tripathi BN attended 17th Convocation of National Academy of Veterinary Sciences (India) and Scientific Seminar on "Livestock Sector towards One Health, Food Security and Safety" jointly organized by Orissa University of Agriculture and Technology Bhubaneshwar, Odisha and national Academy of Veterinary Sciences (India) during December 19-20, 2018.

33. Tripathi BN delivered an invited lecture entitled "Equine Glanders: Still unconquered" at 7th Pan Commonwealth Veterinary of Commonwealth Veterinary Association, held at Bangalore during March 03-07, 2019.

34. Tripathi BN delivered an invited lecture at NDRI Global Alumni Scientific Meet (NGASM – 2019) at NDRI, Karnal on the topic entitled "Achieving sustainable production of milk through control of infectious diseases in dairy Cattle and Buffaloes' on March 16, 2019.

35. Vaid RK attended Seminar on Elsevier empowering agriculture research in India in association with CeRA held at CCS Haryana Agriculture University, Hisar at CBS &H Auditorium, CCS HAU, Hisar on August 24, 2018.

36. Vaid RK as Coordinator, BIF-NRCE of DBT, attended DBT-National Bioinformatics Network Meet at ICGEB, New Delhi on August 29, 2018.

37. Vaid RK participated and presented a lecture presentation on '*Gandhi ji ka Bharat ke swatantrata aandolan me yogdaan*' in Program commemorating 150th Birth Anniversary of Mahatma Gandhi in NRCE, Auditorium on October 2, 2018.
38. Vaid RK attended 'Pathogen Genomics Brainstorming meeting' held at DBT at New Delhi on November 19, 2018.
39. Vaid RK attended Asian Buffalo Congress (ABC-2018) on 'Climate Resilient Buffalo Production for sustainable livelihood at CIRB, Hisar during February 1-4, 2018.
40. Vaid RK participated in the XIV Agricultural Science Congress 2019 during February 20-23, 2019.
41. Vaid RK attended 'Symposium on Advances in Equine Health and Management' organized by NRCE and IAVMI at NRCE, Hisar on February 27, 2019.
42. Yash Pal participated in National Brainstorming Workshop: NADS(I) at ICAR-CIRB, Hisar on July 20, 2018.
43. Yash Pal participated in brainstorming session on the topic "National use of weather forecast for livestock management in agro-meteorological services" at ICAR-NDRI, Karnal on November 24, 2018.
44. Yash Pal participated in XXVII Annual conference of Society of Animal Physiologists of India & National symposium on "Augmentation of animal productivity under changing socio-economic scenario" at ICAR-NDRI, Karnal during November 27-28, 2018.
45. Yash Pal participated and presented report of "Hisar Centre" in Workshop of AICRP on Utilization of Animal Energy with Enhanced System Efficiency at IGKV, Raipur during December 3-5, 2018.
46. Yash Pal participated in XVI Annual Convention of Society for Conservation of Domestic Animal Biodiversity (SOCDAB) and National Symposium on "Sustainable Management of Livestock and Poultry Diversity for enhancing the Farmers' Income" at ICAR-NBAGR, Karnal, Haryana during February 6-7, 2019.
47. Yash Pal participated in one day Symposium of Indian Association of Veterinary Microbiologists, Immunologists and Specialists in Infectious Diseases (IAVMI) on 'Advances in Equine Health & Management' organized at ICAR-National Research Centre on Equines, Hisar on February 27, 2019.

Important meetings attended by Dr BN Tripathi, Director, NRCE

1. Tripathi BN attended 2nd meeting of Task Force on Translational Research and Product Development in Veterinary Vaccines and diagnostics at DBT office, New Delhi on May 21, 2018.
2. Tripathi BN attended a meeting as special invitee and one of the panelists at National Brainstorming workshop on "Role of Buffalo in Indian Economy" organized by National Academy of Dairy Science (India) in collaboration with ICAR- Central Institute for Research on Buffaloes, Hisar on July 20, 2018.
3. Tripathi BN attended the meeting of Expert Committee in the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers welfare, Govt of India, to review the status of equine disease diagnosis being carried out by the approved laboratories on August 01, 2018.
4. Tripathi BN attended the meeting of Breed Registration Committee under the Chairmanship of Dr. Joykrushna Jena, Deputy Director General (Animal Sciences) at ICAR, Krishi Bhavan, New Delhi on September 05, 2018.

5. Tripathi BN attended the Review Meeting at DADF, Ministry of Agriculture & Farmers Welfare to discuss on the progress on the National Glanders Eradication Programme at Krishi Bhawan, New Delhi on October 12, 2018.

6. Tripathi BN attended the review meeting regarding the status of Glanders in Madhya Pradesh and delivered an Expert Lecture on current situation of glanders in Madhya Pradesh"Control and Eradication of glanders in India" on January 24, 2019. In this line Animal Husbandry Department, Govt of Madhya Pradesh, has organized a workshop on 'National animal disease control programme and important emerging diseases of livestock' on 14.02. 2019. A total 170 Veterinary Officers across Madhya Pradesh participated in the workshop. Participants were informed about 'New trends in diagnosis and control of equine glanders'. More emphasis was given for carrying out intensive surveillance activity on equine glanders in Madhya Pradesh.

On-going Research Projects

Sr. No.	Title	Team
EQUINE HEALTH		
1.	Surveillance, Monitoring and Control of Emerging and Existing Diseases of Equines (Apr. 1997 - Continuous Service Project)	HS Singha*, SC Yadav, BR Gulati, Rajender Kumar, Sanjay Kumar, N Virmani, Sanjay Barua, RK Vaid, RK Dedar, Anju Manuja, Balvinder Kumar and BN Tripathi
2.	Nanobased therapeutic interventions against osteoarthritis (Apr. 2016 - Mar. 2019	Anju Manuja*, Balvinder Kumar and Riyesh T.
3.	*In vitro* growth inhibitory efficacy of different herbal plant extracts against *Theileria equi* and identification of principal drug molecule(s) thereof (Sep. 2017 - Aug. 2019)	Sanjay Kumar* and Rajender Kumar
4.	Development of recombinant EHV1 viruses employing bacterial artificial chromosome mediated mutagenesis and their pathological evaluation in murine model)Apr. 2017 - Mar. 2020)	Nitin Virmani*, B.C. Bera, Taruna Anand and B.N.Tripathi
5.	Diagnosis and sequence typing of strains of Streptococcus equi (Apr. 2018 - Mar. 2021)	Balvinder Kumar*, RK Vaid, Anju Manuja, K. Shanmugasundram, H S Singha
6.	Comparative pathology of reverse genetics engineered equine influenza virus(es) in murine model (Apr. 2018 - Mar. 2019)	Nitin Virmani*, Taruna Anand, BC Bera, BN Tripathi
7.	Characterization of Equine herpesvirus isolates in India and documentation of their genetic diversity (Sep. 2018 - Aug. 2021)	BR Gulati*, Naveen Kumar, Riyesh T.
EQUINE PRODUCTION		
1.	Genetic characterization of Marwari horses for selection of true to breed animals (Jul. 2015 - Jun. 2019)	Anuradha Bhardwaj*, Yash Pal, SC Mehta (wef May 2018), AK Gupta (upto October, 2017), Mamta Chauhan (upto June, 2018) and Vijay Kumar (upto March, 2017)
2.	Approaches to the diagnosis and management of reproductive failure in equines (May 2016 - Mar. 2019)	TR Talluri*, J Singh, RK Vaid and RA Legha (SK Ravi, PI upto 7August, 2018)
3.	Assessment and optimization of equine management in an intensive system (Jun. 2016 - Service Project)	SC Mehta*, RA Legha, Yash Pal, RK Dedar, PA Bala, TR Talluri, SK Ravi (upto 7 August, 2018) and J Singh.
4.	Area specific mineral mixture for equine of Rajasthan (May 2016 - Oct. 2018)	RK Dedar* and R Nehra (RAJUVAS) (PA Bala, PI upto 7th August, 2018)
5.	Assessment of risk factors of equine laminitis and colic (Sep. 2016 - Aug. 2019)	RK Dedar*, PA Bala (upto 7 August, 2018), Sakar Palecha (RAJUVAS)
6.	Enduracne and fertility analysis in indigenous horses using SNP (single nucleotide polymorphisms) markers (Oct. 2017 - Sep. 2020)	SC Mehta*, RK Dedar, TR Talluri and SK Ravi (upto 7 August, 2018)
7.	Assessment, evaluation and identification of physical, biochemical and genetic factors affecting stallion fertility (Apr. 2018 - Mar. 2021)	TR Talluri*, SC Mehta, Yash Pal, Anuradha Bhardwaj
8.	Development of rapid diagnostic test for pregnancy diagnosis in horse mares (Jan. 2015 - Dec. 2018)	Yash Pal*, Sanjay Kumar, (AK Gupta, PI upto October, 2017) and SK Ravi (upto 7 August, 2018)
9.	Studies on antitumor and antiviral potential of some plant extracts (Nov. 2018 - Oct. 2019)	RK Dedar*, Naveen Kumar and BN Tripathi
10.	Studies on bioactive components of donkey milk and its application (Jan. 2016 - Mar. 2020)	Anuradha Bhardwaj, Yash Pal, Varij Nayan, RA Legha and Hema Tripathi

Sr. No.	Title	Team
NATIONAL CENTRE FOR VETERINARY TYPE CULTURES		
1.	Authentication and accessioning of viruses of animal origin (May 2015 - Service Project)	Sanjay Barua*, Naveen Kumar, BC Bera, Riyesh T and Taruna Anand
2.	Phenotypic and genotypic authentication and preservation of network bacterial isolates (Jun. 2015 - Mar. 2020)	RK Vaid*, Taruna Anand, BC Bera, Riyesh T and K Shanmugasundaram
3.	Development of bacteriophage repository and exploring the therapeutic potential of phages and their encoded endolysin (Apr. 2017 - Mar. 2020)	Taruna Anand*, Nitin Virmani, RK Vaid and BC Bera
4.	Isolation, characterization and reposition of enteric viruses of poultry (Jun. 2017 - May 2020)	NCVTC: Riyesh T*, Naveen Kumar, Sanjay Barua and LUVAS: Naresh Jindal
5.	Isolation, characterization and generation of repository of Mycobacterium species (Oct. 2017 - Sep. 2020)	Shanmugasundaram K*, RK Vaid, BC Bera and BN Tripathi
6.	Development of Knockout cell by CRISPR/Cas9-mediated genome editing (Apr. 2018 - Mar. 2019)	Naveen Kumar*, Sanjay Barua, Riyesh T, Balvinder Kumar
7.	Prevalence studies for porcine respiratory viruses and development of their repository (Jan. 2016 - Mar. 2020)	BC Bera*, Sanjay Barua, Taruna Anand, N Virmani (Co-PI upto 8 August, 2018)
EXTERNALLY FUNDED PROJECTS		
1.	All India Coordinated Research Project on Utilization of Animal Energy with enhanced system efficiency (AICRP on UAE) (Jul. 2009 - Mar. 2020)	RA Legha* and Yash Pal
2.	National Fellow Scheme-Development of sensitive and specific diagnostic assays for detection of *Trypanosoma evansi* infection in animals using modern molecular tools (Apr. 2011 - Apr. 2019)	Rajender Kumar*
3.	DBT-NER Project on Advanced Animal Disease Diagnosis and Management Consortium (ADMaC) (Apr. 2014 - Sep. 2019)	BN Tripathi*, Sanjay Barua, Nitin Virmani, SC Yadav, BR Gulati, Rajender Kumar, RK Vaid, BC Bera, Taruna Anand and Riyesh T
4.	All India Network Programme on Neonatal Mortality in Farm Animals (Jan. 2015 - Mar. 2020)	Sanjay Kumar*, RK Dedar and BR Gulati (upto 16 April, 2018) Nitin Virmani (upto 8th Aug., 2018), RK Vaid, HS Singha
5.	CRP on Vaccines and Diagnostics (May 2015 - Mar. 2020)	BR Gulati*, Component-I (BR Gulati, Nitin Virmani). Component-II (Nitin Virmani, BR Gulati, BC Bera). Component-III (Sanjay Kumar, Rajender Kumar). Component-IV (Nitin Virmani, T Ananad, BC Bera)
6.	Seroproteome analysis of recombinant secretory proteins of *Burkholderia mallei* towards development of multiple antigen immunoassay for improved diagnosis of glanders (Jul. 2017 - Mar. 2020)	HS Singha* & K Shanmugasundaram
7.	Molecular epidemiology of Japanese Encephalitis Virus in Pigs and Mosquitoes in Assam (DBT Twinning Programme) (Jan. 2017 - Dec. 2019)	PI from Parent Institute: Seema Rani Pegu*, Dilip Kumar Sarma, Swaraj Rajkhowa and PI from Collaborative Institute: BR Gulati
8.	Scheduling Equines from Fatal Zoonotic disease-Glanders and Equine Infectious Anemia (EIA) in India using Point of Care Diagnostic (POCD) (Mar. 2018 - Mar. 2020)	HS Singha* and BN Tripathi
9.	Elucidating therapeutic role of bacteriophages and encoded endolysins against multidrug resistant enteric pathogens of poultry (Jun. 2018 - May 2021)	Taruna Anand*
10.	Exploration of genomic signatures for indigenous horses using next-generation sequencing approaches (DST-SERB) (Dec. 2018 - Mar. 2019)	Anuradha Bhardwaj*
11.	Pathogenicity and Immunogenicity of recombinant neurogenic and non neurogenic mutant equine herpesvirus 1 (in tissue explants and murine Model) and their potential as a vaccine candidates(s) (Jan. 2016 - Mar. 2019)	Nitin Virmani*
12.	Investigating mechanism underlying acquisition of antiviral drug resistance against host targeting agents. (Mar. 2019 - Mar. 2022)	Naveen Kumar* and Sanjay Baura

Staff at NRCE

Director : Dr BN Tripathi

SCIENTIFIC STAFF

Main campus, Hisar

1. Dr Suresh Chander Yadav, Principal Scientist
2. Dr Yash Pal, Principal Scientist
3. Dr Baldev Raj Gulati, Principal Scientist
4. Dr Rajender Kumar, Principal Scientist & National Fellow
5. Dr Nitin Virmani, Principal Scientist
6. Dr Sanjay Kumar, Principal Scientist
7. Dr Anju Manuja, Principal Scientist
8. Dr Balvinder Kumar, Principal Scientist
9. Dr Mamta Chauhan, Sr Scientist (till 21.06.2018)
10. Dr Anuradha Bhardwaj, Scientist
11. Dr Harishankar Singha, Scientist
12. Dr Hema Tripathi, Principal Scientist, CIRB*

*Additional duty for one day/week at NRCE.

Equine Production Campus, Bikaner

1. Dr S.C. Mehta, Principal Scientist
2. Dr Ram Avatar Legha, Principal Scientist
3. Dr Ramesh.Kumar Dedar, Scientist
4. Dr Prokasananda Bala, Scientist (till 07.07.2018)
5. Dr Thirumala Rao Talluri, Scientist
6. Dr Sanjay Kumar Ravi, Scientist (till 09.07.2018)

NCVTC, Hisar

1. Dr Praveen Malik, Principal Scientist (on deputation)
2. Dr Sanjay Barua, Principal Scientist
3. Dr Rajesh Kumar Vaid, Principal Scientist
4. Dr Naveen Kumar, Principal Scientist
5. Dr Taruna Anand, Scientist
6. Dr Bidhan Chandra Bera, Scientist
7. Dr Shanmugasundaram Karuppusamy, Scientist
8. Dr Riyesh Thachamvally, Scientist

ADMINISTRATIVE STAFF

Main campus, Hisar

1. Sh. A.G. Barapatre, Administrative Officer
2. Smt. Shammi Tyagi, Finance & Accounts Officer*

*FAO of CIRB, Additional duty at NRCE.

3. Sh. Ram Pal, Assistant Administrative Officer
4. Sh. Surender Pal Kaushik, Assistant Administrative Officer
5. Sh. Ashok Kumar, Personal Assistant
6. Sh. Subhash Chander, Assistant
7. Sh. Sunil Sharma, Assistant
8. Sh. Pratap Singh, Upper Division Clerk
9. Sh. Dinesh Datt Sharma, Upper Division Clerk
10. Sh. Om Parkash, Upper Division Clerk
11. Sh. Deepak Kumar, Lower Division Clerk

Equine Production Campus, Bikaner

1. Sh. Mahender Singh, Lower Division Clerk

TECHNICAL STAFF

Main campus, Hisar

1. Sh. Krishan Kumar Gupta, Chief Technical Officer (till 31.05.2018)
2. Sh. Kirpa Shankar Meena, Senior Technical Officer
3. Sh. Partha Pritam Chaudhary, Senior Technical Officer
4. Sh. Diger Dev Pandey, Senior Technical Officer
5. Sh. Sita Ram, Senior Technical Officer
6. Sh. Ajmer Singh, Technical Officer
7. Sh. Sanjeev Kumar, Technical Officer
8. Sh. Sajjan Kumar, Technical Officer
9. Sh. Suresh Kumar, Technical Officer
10. Sh. Joginder Singh, Senior Technical Assistant
11. Sh. Mukesh Chand, Senior Technical Assistant
12. Sh. Raj Kumar Dayal, Senior Technical Assistant.
13. Sh. Arun Chand, Senior Technician
14. Sh. Raghbir Singh, Senior Technician

Equine Production Campus, Bikaner

1. Dr Jitender Singh, Senior Technical Officer
2. Sh. Kamal Kumar Singh, Senior Technical Officer
3. Sh. Brij Lal, Technical Officer
4. Sh. Narender Chauhan, Technical Officer
5. Sh. R.A. Pachori, Technical Officer
6. Sh. S.N. Paswan, Senior Technical Assistant
7. Sh. Om Parkash, Senior Technical Assistant
8. Sh. Rajender Singh, Technical Assistant
9. Sh. Gopal Nath, Technician

SKILLED SUPPORTING STAFF

Main campus, Hisar

1. Sh. Ishwar Singh
2. Sh. Guru Datt Sharma
3. Sh. Jai Singh
4. Sh. Mahabir Prasad
5. Sh. Ramesh Chander
6. Sh. Mardan
7. Sh. Desh Raj
8. Sh. Ishwar Chander
9. Sh. Om Parkash
10. Sh. Hanuman Singh
11. Sh. Subhash Chander
12. Sh. Ishwar Singh
13. Sh. Ram Singh
14. Smt. Santra
15. Sh. Sant Ram
16. Sh. Soma Devi
17. Sh. Lilu Ram

Equine Production Campus, Bikaner

1. Sh. Raju Ram
2. Sh. M.P. Meena
3. Sh. Ashok Kumar

NRCE in News

भास्कर विशेष

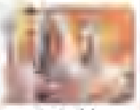
स्टेट फैक्ट

6205

हिसार

जानलेवा • अमरनाथ, वैष्णो देवी यात्रा समेत देशभर की मंडियों और छावनियों में हो रहा घोड़ों का इस्तेमाल, सबसे अधिक यूपी में ग्लैंडर्स बीमारी से ग्रसित घोड़े मिले

एनआरसीई ने 17 राज्यों से घोड़ों के खून का किया परीक्षण, 339 में मिली ग्लैंडर्स बीमारी



क्या है ग्लैंडर्स रोग

2010 की गणना के अनुसार घोड़ों की संख्या

कार्यक्रम • राष्ट्रीय अश्व अनुसंधान केंद्र ने विश्व में पहचान बनाई : डॉ. एमपी यादव

राष्ट्रीय अश्व अनुसंधान केंद्र में स्थापना दिवस पर घुड़सवारों ने दिखाए करतब

भास्कर न्यूज | हिसार

घोड़ों को पब्लिक मूवमेंट से रोकना होगा

पीटा के सीईओ डॉ. मनीलाल ने कहा, एक भी पॉजिटिव सैंपल खतरनाक

एनआरसीई 20 गधी लाया, दूध से त्वचा निखरेगी

गुजरात की हलारी गधियों के दूध से बनेंगे ब्यूटी प्रोडक्ट, फार्म हो रहा तैयार

भास्कर न्यूज | हिसार

NRCE in News

ग्लैंडर्स बीमारी को लेकर दिल्ली सरकार गंभीर नहीं

एनआरसीई ने सभी मुख्य संस्थाओं को भेजा पत्र

सुमीत केसीवाल • हिसार

नेशनल रिसर्च सेंटर ऑन एक्वाइन के निदेशक बीएन त्रिपाठी ने दिल्ली के पशुपालन विभाग पर पशुओं की बीमारी ग्लैंडर्स को गंभीरता से न लेने के आरोप लगाए हैं। एनआरसीई के निदेशक के पत्र के मुताबिक यदि दिल्ली सरकार गंभीर नहीं हुई तो जल्द ही इस बीमारी के मनुष्यों में फैलने का खतरा पैदा हो जाएगा।

हुआ यह कि एक साल से कोई सैंपल नेशनल रिसर्च सेंटर ऑन एक्वाइन हिसार नहीं भेजे गए तो एक पशुपालक स्वयं सैंपल लेकर हिसार पहुंचा। सैंपल पॉजिटिव मिला तो निदेशक ने वैज्ञानिकों की टीम गठित कर दिल्ली भेजी। टीम ने पशुपालन विभाग दिल्ली से संपर्क कर 50 सैंपल लिए। इनमें से आठ सैंपल पॉजिटिव पाए गए। अब एनआरसीई ने दिल्ली सरकार, पशुपालन विभाग दिल्ली, आइसीएआर, नीति आयोग, एग्रीकल्चर मिनिस्ट्री आदि सभी बड़ी संस्थाओं को पत्र लिखा है। पत्र में कहा गया है कि दिल्ली सरकार ने गंभीरता नहीं दिखाई तो प्रशासनिक कार्यालय से उजागर किया जाएगा। अन्यथा जल्द ही यह बीमारी पशुओं से आम आदमी में फैल जाएगी। जिससे महामारी का खतरा पैदा हो जाएगा।

दिल्ली में इस तरह हुआ उजागर

वरिष्ठ विज्ञानी डा. एच सिंह ने बताया कि दिल्ली में सन् 2018 में 26 जनवरी के पास ग्लैंडर्स के केस मिले थे। इसके बाद दिल्ली हाईअलर्ट पर आई थी। वहां एनजीओ ने घोड़े, खच्चर आदि रखने वाले पशुपालकों को जागरूक करने की मुहिम छेड़ी। अप्रैल के आखिरी सप्ताह में दिल्ली के ऐसे ही एक एनजीओ के संपर्क वाला पशुपालक हिसार पहुंचा। वह अपने साथ घोड़ों के सैंपल लेकर आया था। इम्यूनोलॉजिस्ट के अनुमति लेकर सैंपलों की जांच की। सैंपल पॉजिटिव आए तो हमने दिल्ली पशुपालन विभाग से संपर्क किया तो उन्होंने ग्लैंडर्स के केस आने से इनकार किया। निदेशक डा. बीएन त्रिपाठी के आदेश पर एक टीम का गठन किया गया।

दिल्ली में इस प्रकार है आंकड़ा

सन 2017-18	51 पॉजिटिव
सन 2018-19	9 पॉजिटिव
1 से 7 मई 2019	8 पॉजिटिव
दिल्ली के इन एरिया	
मंगोलपुरी	3 पॉजिटिव
विजय विहार	3 पॉजिटिव
गांव नेबसराय	2 पॉजिटिव

नहीं निकाला कोई शोध

डा. बीएन त्रिपाठी ने बताया कि नीति आयोग, आइसीएआर, पशुपालन विभाग दिल्ली आदि के साथ मिलकर 50 से ज्यादा बैठक हो चुकी है। नीति आयोग के आदेश पर ग्लैंडर्स को खत्म करने के लिए 25 करोड़ का प्रोजेक्ट बनाकर दिए हुए एक साल का वक्त बीत चुका है लेकिन आजतक प्रोजेक्ट अटका हुआ है।

16 दैनिक जागरण हिसार, 27 नवंबर 2018

राष्ट्रीय अश्व अनुसंधान केंद्र ने मनाया 34वां स्थापना दिवस

जागरण संवाददाता, हिसार : राष्ट्रीय अश्व अनुसंधान केंद्र ने सोमवार को अपना 34वां स्थापना दिवस मनाया गया। इस मौके पर मुख्य अतिथि डा. एसपी यादव रहे। इस अवसर पर विशिष्ट अतिथि डा. अनिल कुमार श्रीवास्तव ने 2.64 बिलियन भारतीयों के लिए खाद्य एवं पौष्टिक सुरक्षा को प्रस्तुत किया। उन्होंने अश्व विज्ञान के क्षेत्र में संस्थान के योगदान तथा केंद्र को सतत सहयोग एवं अनुसंधान उपलब्धियों के लिए केंद्र की प्रशंसा की। राष्ट्रीय अश्व अनुसंधान केंद्र के निदेशक डा. बीएन त्रिपाठी ने कहा कि केंद्र ने अश्व विज्ञान के क्षेत्र में उत्कृष्ट अनुसंधान एवं नैदानिक सेवाएं प्रदान करने में अग्रणीय स्थान बना लिया है। इस अवसर पर केंद्रीय भैंस अनुसंधान के डा. एसएस दहिया ने सभी को 34वें स्थापना दिवस की बधाई दी। कार्यक्रम में अश्व पालकों और वैज्ञानिकों के साथ संगोष्ठी का आयोजन किया गया। इस दौरान मुख्यातिथि द्वारा अनेक प्रकाशन भी विमोचित हुए। कार्यक्रम का संयोजन डा. संजय कुमार ने किया व मंच संचालन डा. अंजु मनुजा द्वारा किया गया।

1.34 बिलियन भारतीयों के लिए खाद्य एवं पौषणिक सुरक्षा जरूरी : प्रो. अनिल

राष्ट्रीय अश्व अनुसंधान केंद्र में 34वें स्थापना दिवस के उपलक्ष्य पर दिया व्याख्यान

जागरण संवाददाता, हिसार : भारतीय कृषि के बढ़ते कदम एवं कृषकों की अथक मेहनत से हम 1947 में खाद्य कमी और खाद्य आयात से 1980 में खाद्य स्व पर्याप्तता और खाद्य निर्यात तक का सफर तय कर पाए हैं। इसके अतिरिक्त अभी भी 1.34 बिलियन भारतीयों के लिए खाद्य एवं पौषणिक सुरक्षा एक गंभीर विषय बना हुआ है। इसके संदर्भ में गहन विचार-विमर्श के साथ उन्नत कृषि एवं कृषि के नए आयामों का अध्ययन और अनुकरण अति आवश्यक हो गया है। ये बात कृषि वैज्ञानिक चयन मंडल नई दिल्ली के अध्यक्ष डा. अनिल कुमार श्रीवास्तव ने कही। हिसार स्थित राष्ट्रीय अश्व अनुसंधान केंद्र में 34वें स्थापना दिवस के उपलक्ष्य पर स्थापना दिवस व्याख्यान का आयोजन किया गया।

इस अवसर पर गणमान्य अतिथि के रूप में प्रोफेसर डा. अनिल कुमार श्रीवास्तव की ओर से 1.34 बिलियन भारतीयों के लिए खाद्य एवं पौषणिक सुरक्षा विषय पर अति वैज्ञानिक दृष्टिकोण से कृषि के नए तथ्यों एवं नव संभावनाओं को प्रस्तुत किया गया। अपने व्याख्यान में उन्होंने परंपरागत खेती से कृषि प्रौद्योगिकी के नेतृत्व में होने वाली हरी, श्वेत, नीली और पीली कृषि क्रांति के बारे में बताया। हमारे देश में खाद्यान्न का

राष्ट्रीय अश्व अनुसंधान केन्द्र में आयोजित सेमिनार में संबोधित करते कृषि वैज्ञानिक चयन मंडल नई दिल्ली के अध्यक्ष डा. अनिल कुमार श्रीवास्तव। • जागरण

उत्पादन 1966 में 75 मिलियन टन से बढ़कर 2017.18 में 277.48 मीट्रिक टन हो गया है। 1951 से 2017-18 के बीच हमने खाद्य अनाज उत्पादन में 51 से 277.48 मीट्रिक टन, बागवानी उत्पादन में 40 से 305.4 मीट्रिक टन, दूध उत्पादन में 17 से 176.35 मीट्रिक टन, मछली उत्पादन में 0.75 से 10.8 मीट्रिक टन, मांस उत्पादन में 7.37 मीट्रिक टन और अंडा उत्पादन में 88.1 अरब की बढ़ोतरी प्राप्त की है। अभी भी भविष्य के लिए भारतीय परिपेक्ष्य में खाद्य एवं पौषणिक सुरक्षा पर बहुत कार्य करने की आवश्यकता है। भारत में खाद्य प्रसंस्करण क्षेत्र 8 फीसद प्रति वर्ष की दर से बढ़ रहा है। हमारे देश में 32 मिलियन टन की वर्तमान क्षमता के मुकाबले 61 मिलियन टन भोजन के लिए ठंडे भंडारण की आवश्यकता है। पंजीकृत और अपंजीकृत खाद्य प्रसंस्करण क्षेत्रों में लगे कार्य बल क्रमशः 17.41 और 47.9 लाख हैं और सरकार विशेष कृषि प्रसंस्करण क्षेत्र स्थापित करने के लिए प्रोत्साहित कर रही है। एमओएफपीआइ का आवंटन 2018.19 में 2017.18 की तुलना में दोगुना होकर 1,400 करोड़ रुपये हो गया है।

कृषि के साथ-साथ पशु पालन भी जरूरी

भारतीय किसानों ने गेहूं के उत्पादन में काफी प्रगति हासिल की है। वर्तमान में भारतीय कृषि नई तकनीकों के समन्वय से बहुत प्रगति कर रही है। भारत में दुनिया के 17 फीसद मानव और 12 फीसद पशुधन आबादी का निवास है। 2050 तक जमीन, पानी, जैव विविधता 30-50 फीसद तक कम हो जाएगी। इसलिए फसलों के साथ-साथ पशुधन, मत्स्य पालन, दुग्ध उत्पादन पर भी ध्यान देने की जरूरत है। खाद्य एवं पौषणिक सुरक्षा के लिए पशुधन का अधिकाधिक प्रयोग कर के नई तरह के पशुपालन पद्धति द्वारा लक्ष्यों को प्राप्त किया जा सकता है। उन्होंने वैज्ञानिकों, पशु-चिकित्सकों और पशु-पालकों को अपने ऊर्जस्वी व्याख्यान द्वारा भविष्य के लिए खाद्य एवं पौषणिक सुरक्षा पर कार्य करने के लिए प्रेरित किया। विश्व में प्रति व्यक्ति दूध की उपलब्धता 229 ग्राम प्रतिदिन है। जबकि भारत में यह 355 ग्राम प्रतिदिन है। वहीं, केंद्र के निदेशक डा. बीएन त्रिपाठी ने उनकी जीवनी एवं उपलब्धियों पर प्रकाश डाला एवं उनके द्वारा दिए गए स्थापना दिवस व्याख्यान के लिए आभार प्रकट किया।

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