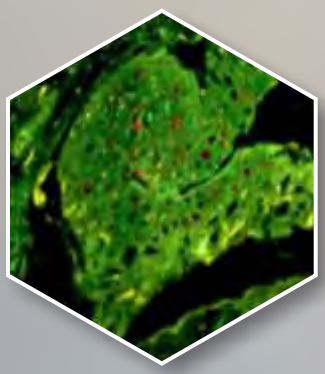
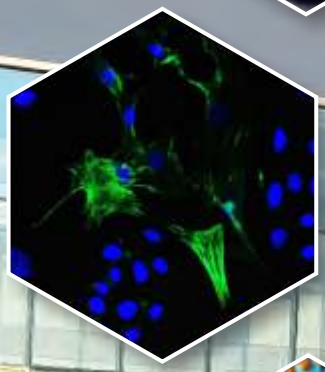
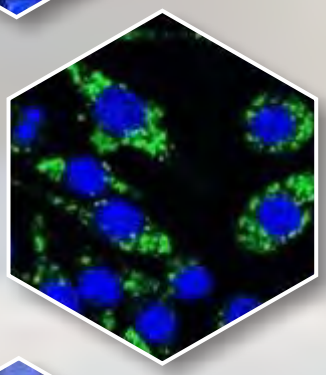
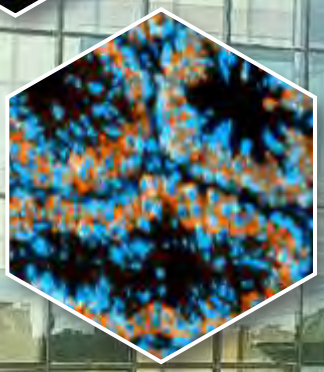
Annual Report 2019-20

NIAB
National Institute of Animal Biotechnology

Photographs used in the Annual Report have been captured in the campus of NIAB

NIAB

National Institute of Animal Biotechnology

वार्षिक प्रतिवेदन
Annual Report
2019-20

राष्ट्रीय पशु जैव प्रौद्योगिकी संस्थान

National Institute of Animal Biotechnology

(An autonomous Institute of the Department of Biotechnology, Ministry of Science & Technology, Govt. of India)

Opp. Journalist Colony, Near Gowlidoddi, Extended Q City Road, Gachibowli

Hyderabad, Telangana, India PIN: 500 032

Email:admin@niab.org.in // Web: www.niab.org.in

MISSION:

Development of sustainable and globally competitive livestock based economy through innovative science & technology development and entrepreneurship promotion.

VISION

To demonstrate excellence in science; develop technology and solutions in animal biotechnology leading to eventual commercialization.

OBJECTIVES:

1. To undertake directed, basic and applied research towards technology and product innovation. Characterization of breeds and selective breeding to enhance productivity; develop technologies for multiplication of elite genotypes. Development of transgenic animals for producing molecules of pharmaceutical value. Enrichment of crop residues into high value products. Development of new generation vaccines, diagnostics and drugs.
2. To develop human resource across the value chain, primarily for translational research, industrial R&D; facilitate introduction of short term advanced training, new courses like MSc/ MVSc-PhD and Ph.D. degree with a focus on interdisciplinary science, innovation and the science of manufacturing.
3. To contribute to national policy formulation related to animal biotechnology, animal bio-safety issues and ethical issues.
4. To promote intellectual property protection, business development, technology transfer, and academia-industry partnerships.
5. To develop collaborative programmes with national and international partners with focus on translational research and product development.
6. To provide incubation facilities for entrepreneurs/startup companies.
7. To create (i) extramural centers with emphasis on product innovation and translational research (ii) 'not for profit' companies; and (iii) facilitate the creation of 'for profit' companies

Human resource & Scientific Achievement

Major Heads	Upto 31-3-2019	During 19-20	Total upto 31-3-2020
Publications	60	25	85
Patents filed	2	4	06
Awards	11	08	19
Extra Mural grants received	45	03	48
Conferences and Workshop organised	14	02	16
Ph.D students	34	10	44
Scientific / Technical / Admin Staff	37	01	38

From The Desk of Director

From the Desk of Director

I have a great pleasure in presenting the 2019-20 Annual Report of the National Institute of Animal Biotechnology (NIAB), an autonomous institute under the administrative control of the Department of Biotechnology (DBT), Ministry of Science & Technology, Government of India.

NIAB aims to harness novel and emerging biotechnologies and take up research in the cutting edge areas for improving animal health and productivity. The Institute's focus of research is on animal genetics and genomics, transgenic technology, animal diseases, reproductive biotechnology, bioinformatics and nutrition enrichment. The institute focuses on research which would lead to the development of novel vaccines, diagnostics and improved therapeutic molecules for farm animals.

The ongoing research projects in the area of infectious diseases include those on brucellosis, leptospirosis, staphylococcosis. Newcastle disease, babesiosis, theileriosis and toxoplasmosis. Host-pathogen interactions, virulence mechanisms, and molecular pathogenesis are being studied with the ultimate objective of technology and product innovation for development of efficient diagnostic tools and novel vaccines. During the reporting period, NIAB has also initiated studies of cattle genomics using state of art next generation sequencing. This will allow to determine purity of breeds and help in conservation of valuable indigenous breeds of cattle.

During the period of 2019-20, NIAB scientists were involved in the following major projects

- Genomic selection for conservation of indigenous cattle breeds.
- Genomics assisted pathobiology to identify novel targets for diagnosis and therapeutic intervention(s) of Japanese encephalitis and Leptospirosis and development of a sensor for rapid detection of Japanese encephalitis virus.
- Production of therapeutic protein (human Interferon-gama and bone morphogenetic protein in milk.
- Development of point-of-care diagnostics for snake venom detection upon snake bite in farm animals.
- Aptamer based lateral flow device for detection of heat or estrous in buffalo.
- Affordable diagnostics for detection of antibiotics in milk and assessment of udder health.
- Molecular fingerprinting and genomics of bovine mastitis-associated Staphylococci, and explorations on potential anti-biofilm agents.
- Understanding the virulence mechanisms of the zoonotic pathogen, Brucella.
- Development of novel immune-modulators/ adjuvants for veterinary vaccines.
- Host pathogen interaction studies on animal and avian viruses.

Institute scientists published 25 papers and filed 4 patents during the reporting year and received many extra mural funding from different funding agencies. Many distinguished lectures were also organized in this year.

In order to strengthen the foreign collaboration, MoU was signed with International Livestock Research Institute (ILRI), Nairobi, Kenya

Institute is strengthening the academic programme also through "Research Scholar Programme" where NIAB has MoU with Regional Centre of Biotechnology, Manipal University and the University of Hyderabad for PhD registrations of the Research Scholars.

During this year, NIAB had organized linkage meeting on DBT flagship programme entitled "Genomic associated pathobiology to identify novel targets for therapeutic invention against Japanese Encephalitis and Leptospirosis". Also, brainstorming session and training on "Livestock genomics for conservation of indigenous cattle" was organized on 10-11 Sep 2019

Bridge programme was initiated in order to connect, NIAB scientists with national educational needs of schools and colleges. The aim is to generate excitement towards science in young minds. Lectures and practical are conducted in various higher secondary schools. In addition, school and college students frequently visit NIAB so as to have an exposure of research scenario in biotechnology. During 2019-20, total 94 lectures were delivered by NIAB scientists at various schools in Hyderabad. Also open days were observed for school and college students.

During the period of report, Small Animal Facility and Large Animal Farms became operational. The Large Animal Facility (LAF) of the Institute was inaugurated by Dr. Manju Sharma, Former Secretary, Department of Biotechnology in the presence of Dr G. Padmanaban, Former Director, Indian Institute of Science (IISc) and Dr V.P Kamboj, Former Director of Central Drug Research Institute (CDRI) on 23rd December 2019

Finally, I sincerely acknowledge the support, encouragement and advice received from the distinguished members of the NIAB Society, Governing Body, Scientific Advisory Committee, Finance Committee and Building Committee, as well as the support of the Department of Biotechnology, in furthering the activities of NIAB. The support of local institutions like CDFD, CCMB, University of Hyderabad, TS Veterinary University and others is greatly appreciated. I also acknowledge the contributions of the cohesive team of highly dedicated scientific, technical and administrative staff of NIAB for their untiring efforts in meeting our objectives.

In the years to come, I sincerely hope and wish for continued support and encouragement to strengthen the institute to reach greater heights of excellence in the mandated areas of its research activities.

Dr Subeer S Majumdar

Research Projects

A. Animal Genomics and Reproduction

Title: Livestock Genomics for Cattle Improvement and Transgenic Farmed Animals

Subeer S. Majumdar

Principal Investigator: **Dr. Subeer S. Majumdar**

Scientist B:
Dr. Satya Pal Arya
(up to Nov 2019)

PhD students:
Neelam Topno
Abhishek Das
Goutam Ulgekar
Venkateswaran Ganeshan

Project Fellows/Trainees:
Amit Pal
Satarupa Dutta
Dhirendra Suthar
Anindita Ghosal
Arpita Mahapatra (Dec 2018 to June 2019)
Vaishnavi (Since Jan 2020)

Collaborators:

Dr. S. Khadse	BIAF, Pune
Dr. Nirmalya Ganguli	NIAB, Hyderabad
Dr. Kadirvel Govindsamy	ICAR Centre for NEH Region, Shilong
Dr. John Hicxky	Roslin Institute, UK
Benjamin Rosen	USDA, USA
Curt Van Tassel	USDA, USA

Theme of Research:

Conservation of indigenous cattle breed and determination of purity of breed. Transgenesis in farm animals for producing therapeutic protein in milk and avenues for generating more female calves through manipulation of spermatogenesis.

Objective

1. Genotyping through development of HD SNP chip based on NGS data obtained from indigenous cattle breed for determination of purity of breed and conservation of germ pool of native breed.
2. To develop easier methods for farm animal transgenesis and non-transgenic animal bioreactor. To use these technologies for increased milk yield and production of therapeutic proteins in the milk.
3. To generate males, favouring fertilization with X bearing sperm, to produce more female offspring.

1. Genomic Selection for conservation of indigenous cattle breeds and enhancing milk yield.

This project is using a genomics based approach for identification of pure animals and estimation of genetic

mixing in graded cattle. For achieving these objectives, we have used Next Generation Sequencing (NGS) to sequence five indigenous cattle breeds namely, Gir, Sahiwal, Tharparkar, Red Sindhi and Kankrej and also 2 samples each of rest of the 38 breed of cattle across the country. Sequencing data generated will be used for extraction of SNPs and development of a HD chip. This HD chip will be used for genotyping all the 40 registered indigenous cattle breeds. Genetic makeup and SNPs of all the breeds shall be revealed by genotyping representative individuals from each breed. We will try to identify genomic signature of each breed and develop a genetic tool and database for evaluating the level of genetic mixing in an individual. We are also sequencing one sample from each of these five breeds of cattle using 10X Genomics Chromium library.

2. Production of Therapeutic Protein (human Interferon-gama and Bone Morphogenetic Protein 2) in Milk:

This work is done in collaboration with Dr. Nirmalya Ganguli of NIAB. We are trying to standardise easy testicular transgenesis in farm animals as well as direct transfection of mammay epithelial cells in vivo. We collected sperm samples from previously electroporated goats and analysed them to detect integration of transgene in the sperm DNA. Genomic DNA was isolated from the sperm and was checked on agarose gel for integrity. We performed Droplet digital PCR of the DNA isolated form the sperm samples. We detected integration of the transgene in the sperm ejaculate with copy number varying in different ejaculate collected at diferent time interval, post epectroporation.

We have initiated the work to standardise various gene delivery methods for direct transfection of mammary epithelial cells in-vivo. We have started Virosome mediated direct transgene delivery in breast gland in-vivo. We have standardised the method of culture of Sendai virus in allantoic fluid of embryonated chicken eggs followed by preparation of virosome entrapping the gene of interest. The functional transgene construct was entrapped into reconstituted Sendai Viral envelope to generate an easy and efficient in-vivo gene delivery system. We have obtained initial success in the rabbit model with expression of exogenous perotein in the milk. We are planning further to scale up the process for in-vivo gene delivery in udder gland of goat. We have also initiated process for generating various nanoparticle for transfecting mammary epithelial cells in-vivo. Among all non-viral transfecting agents chitosan (CS) and polyethyleneimine (PEI) is widely used for their ability to transfect mammalian cells. To increase the efficiency and specificity of the PEI mediated delivery, we explored conjugating various ligands with PEI which targets PEI cell specifically through cell surface receptor. We detected presence of cell surface asialo glycoprotein receptor (ASGPR) on the mammary luminal epitghelial cells in mice and goat. We obtained mammary glands of mice at various developmental stages along with liver (n=3) which serveed as a positive control, followed by isolation of RNA and quantitative Real Time PCR analysis (QRT-PCR). In qRT-PCR analysis we found that ASGPR is expressed in the mammary gland of mice. We also performed immuno histochemistry of the mice mammary gland to detect expression of ASGPR within it. Expression of ASGPR was visualised in the mammary epithelial cells of mice mammary gland (Fig. 1).

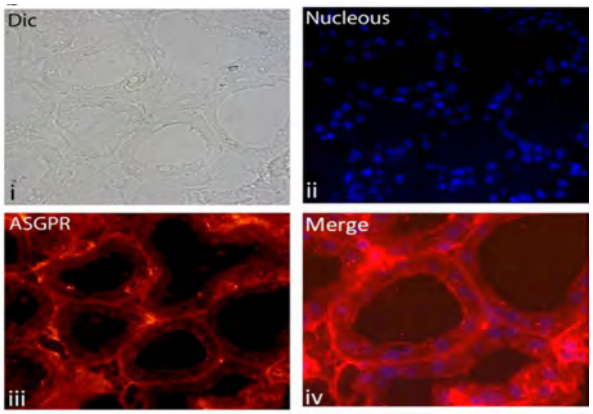


Fig. 1: *Detection of expression of ASGPR in the mammary epithelial cells of mice. Immuno histochemical analysis of cross section of the mice mammary glands for detection of ASGPR expression. Expression of ASGPR was detected in the mammary epithelial cells by antibody specific for ASGPR, followed by counter staining with Alexa flour 546.*

This also helped us to infer that the increase in expression of ASGPR in the lactating gland is probably due to increase in the number of luminal epithelial origin (LEC) in the mammary gland at the time of lactation and not by an increased cellular signalling cascade or surface localisation. In the immuno cytochemistry analysis we found expression of ASGPR in the MCF7 cells (Fig. 2a). We also found expression of ASGPR in the SMA negative Goat mammary epithelial cells (GMEC) specifically (Fig. 2b). These ASGPR positive GMEC looked cyto-architecturally similar to Cyto Keratin 18 (CK18) positive GMEC (Fig. 2b). CK18 is known to be a marker for mammary epithelial cells which are of LEC origin. No fluorescence signal was detected in any of the only secondary antibody treated control slide which lack primary antibody (Fig. 2c).

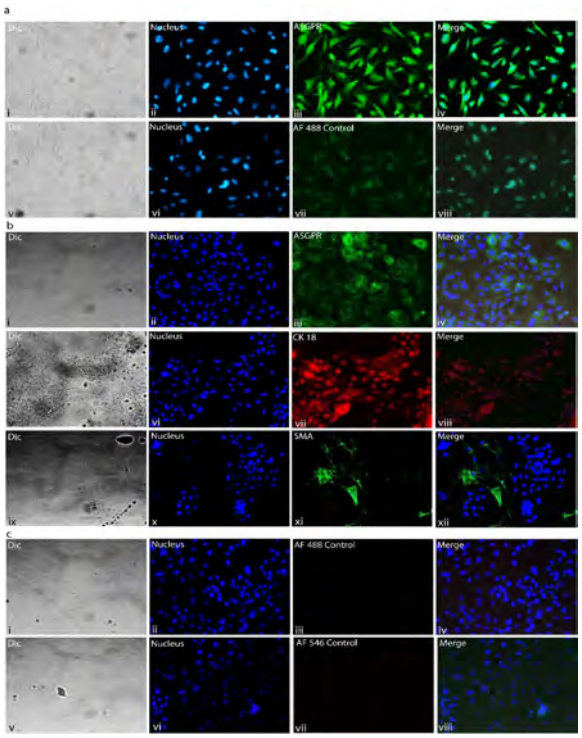


Fig.2: *Detection of expression of ASGPR in the MCF7 cells of human origin and mammary epithelial cells isolated from goat mammary gland tissue. a. Immuno cytochemical analysis of cultured MCF7 cells, for detection of ASGPR expression. Cells were treated with or without primary antibody specific for ASGPR followed by counter staining with Alexa flour 488. Expression of ASGPR was detected specifically in the primary antibody treated cells. b. Immuno cytochemical analysis of cultured mammary epithelial cells isolated from goat mammary gland tissue, for detection of ASGPR expression. Cells were treated with primary antibody specific for ASGPR, CK18 and SMA, followed by counter staining with Alexa flour 488, 546 and 488 respectively. Expression of ASGPR was detected specifically in the SMA negative and CK18 positive cells. c. Immuno cytochemical analysis of cultured mammary epithelial cells isolated from goat mammary gland tissue treated with only secondary antibody Alexa flour 488 and 546. No fluorescence signal was detected in only secondary antibody treated cells. DIC: show the differential interphase contrast image, Nucleus: show the image stained with nucleus stain Hoechst, ASGPR: show the expression of ASGPR in the cells, CK18: show the expression of CK18 in the cells, SMA: show the expression of SMA in the cells, Merge: show the merged image, AF488 Control: cells treated with only secondary antibody Alexa flour 488, AF546 Control: cells treated with only secondary antibody Alexa flour 546.*

These observations all together confirmed that the ASGPR is expressed by the mammary epithelial cells specifically those of LEC. Based on this information we explored the possibility of utilising such LEC specific expression of ASGPR for developing a non-virosomal transgene (Tg) delivery which specifically target LEC in the mammary gland. Galactose (Gal) or N-acetylgalactosamine (GalNAc) is known to be strong ligand for ASGPR. It has been shown that Gal or GalNAc conjugated poly-ethylene-imine (PEI) can be used for hepatocyte specific gene delivery utilising the specific interaction of ASGPR and Galactose moiety. We used 25kd branched PEI (bPEI) and conjugated it with direct Galactose moiety (bPEI-Gal). Further we conjugated it with Transgene and named it bPEI-Gal-Tg. We used Tg conjugated bPEI (bPEI-Tg) as control to assess ASGPR mediated transfection by bPEI-Gal-Tg in the mammary epithelial cells. We used pCMV-hIFNγ-IRES2-EGFP plasmid construct as transgene in which human interferon-γ and EGFP are expressed separately under cyto megalovirus immediate early promoter (CMV). We treated MCF7 cells with these formulations conjugated with transgene. We also considered treating cells with Lipofectamine 2000 along with the same transgene (Lipofectamine-Tg), which served as a lipid based transfection control. Observations of cells, 24 hours post treatment revealed expression of EGFP in all Tg conjugated formulations as compared to non-Tg conjugated control. We observed increased number of EGFP expressing cells in bPEI-Gal-Tg transfected cells as compared to bPEI-Tg and Lipofectamine-Tg transfected cells. We performed ELISA to detect the expression of hIFNγ quantitatively in the cells treated with bPEI-Gal-Tg and bPEI-lGal-Tg along with untransfected control as well as bPEI-Gal treated control. We observed increasing level of expression of hIFNγ with respect to the increasing concentration of transgene in the formulation as detected by ELISA (Fig. 4b). Morphologically the cells looked healthy while treated with bPEI-Gal-Tg as compared to bPEI-Tg or Lipofectamine treated cells.

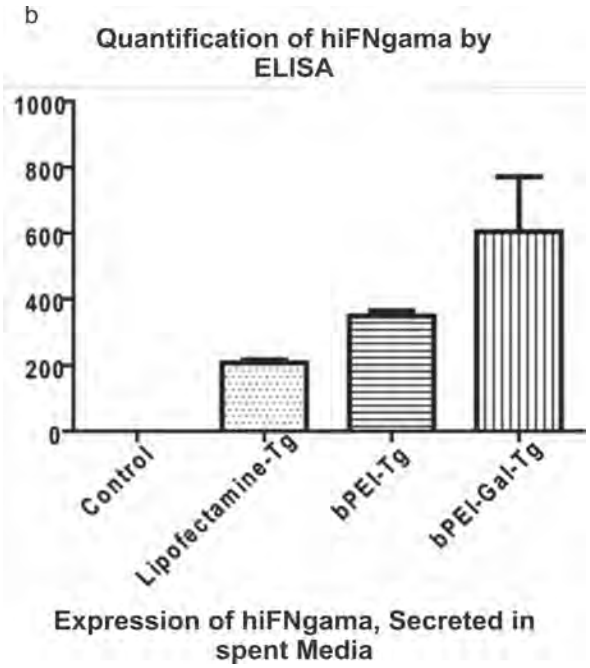


Fig. 3: *Detection of hIFNγ expression in the cells transfected with bPEI-Gal-Tg as compared to bPEI-Tg and Lipofectamine-Tg transfected cells. Increased expression of hIFNγ was detected in the bPEI-Gal-Tg transfected cells as compared to bPEI-Tg and Lipofectamine-Tg transfected cells (N=3, P<0.05).*

We have initiated work of expressing Bone Morphogenetic Protein2 (BMP2) in milk. For this work we procurd cDNA of BMP2 signal peptide which is of ~1200bp in length. This was cloned under CMV promoter initially to check its functionality in cell lines. BMP2 has its endogenous signal peptide which helps it to be secreted. For efficient secretion of BMP2 in milk, we fused signal peptide of beta casein of buffalo origin with it along with its native varient.

At present we are validating the expression of both the BMP2 varients (with endogenous and betacasein signal peptide) in cell lines.

In addition to this, we have initiated pig transgenesis work in collaboration with ICAR institute (ICAR Research Complex for NEH Region, Barapani) in North East.

3. To generate males, producing only X bearing sperm:

Dr. Satyapal Arya was working in collaboration for this. Since there is a need to develop new methods to produce sexed semen, this project is focusing on use of multipronged molecular biology based approach to manipulate spermatogenesis for producing sexed semen naturally from a male animal. For this purpose, we are employing various strategies to kill or slow down Y chromosome containing sperm, so that resultant semen produced have only X chromosome bearing sperm. Such male may produce predominantly female offspring after natural mating. In this project, we have already cloned Apoptosis Inducing Factor (AIF) and Nuclear Apoptosis Inducing Factor (NAIF) genes for inducing cell death in Y chromosome containing sperm and designed shRNA for a sperm motility gene MLL5 for slowing down the Y sperm. We have cloned post meiotic promoter SP10 for achieving post meiotic expression of these genes. We have also cloned truncated bid (t BID) for inducing apoptosis in Y bearing sperm cells. We are using Sperm Motility Kinase-1 (SMOK1) which is known to prevent the transfer of gene products through cytoplasmic bridges during spermatogenesis. We are in the process of standardizing the targetedgene integration using Crispr Cas-9 to target Y chromosome. We are also planning to use magnetic nanoparticles to separate sperm cells. Please note that Dr. Satya Pal Arya has left NIAB.

Publications

1. Bhattacharya I, Sen Sharma S, **Majumdar SS**. Pubertal orchestration of hormones and testis in primates. Mol Reprod Dev. 2019; 86(11):1505-1530.

Lab Photo

Left to right: *Satarupa Dutta, Abhishek Das, Neelam Topno, Subeer S. Majumdar, Venkateswaran Ganeshan, Amit Pal, Goutam Ulgekar, Dhirendra Suthar.*

Title: Reproductive Biology, Gametogenesis, Oocyte atresia, DNA damage response and repair pathways

H.B.D.Prasada Rao

Principal Investigator: **Dr. H.B.D. Prasada Rao**

PhD Students:

Rohit Beniwal

Lavakumar

Aradhana Mohanthy

Project Personnel:

Dr. Ajay Singh-RA

Dr.Bhawna Kushawaha-RA (Since November 2019)

Collaborators:

Dr. Attila Tooth	Dresden University, Germeny

Theme and Objectives of Research

Focus of our laboratory at NIAB are to understand (a) the quality control pathways in oocyte and spermatocyte development to extend livestock fertility, (b) molecular mechanisms of meiotic processes, such as homologous recombination and synapses in livestock to increase the fecundity and to prevent birth defects, (c) causes and treatments of ovarian disorders in livestock.

Work Reported in 2018-2019

(i)Attempt to prolong ovarian life by limiting the death of primordial follicles

Reproductive life is reduced as the age of mothers continues to rise. At present, the optimal fertility of cattle reaches by the age of 3 to 5 and decreases to 50% by the age of 7.5 and most females reach the infertility threshold by the age of 8yrs. Lack of ovarian function leads to infertility and a huge loss to farmers and dairy industry. At present one of the serious problems is the rehabilitation of aged cattle. This program became the biggest problem to the government. Thus increase in the fertility lifespan of the cattle would be a great help to the Indian farmers.

Despite the importance and huge loss at primordial follicle stage, how the primordial follicle atresia is regulated is largely unknown. In rodent's, loss of fetal oocytes has been shown to occur via apoptotic mechanisms. However, the molecular mechanisms behind oocyte or primordial follicle loss are not known. In this proposal, we are trying to prolong the ovarian life by finding novel primordial follicles apoptosis checkpoint proteins which would be modulated to prevent the death of primordial follicles.

In our previous report we have concluded that P63 dependent oocyte quality checkpoint mechanisms are conserved in the goat. We found that in early fetal and adult ovaries very few number of oocytes shows the positive signal for P63 whereas around birth 90% of oocytes shows P63 staining indicates that the majority of the oocytes undergo death after birth but not in adults. These results clearly indicate that the oocyte apoptosis in ovaries particularly primordial and primary oocytes depends on the P63 check point pathway and the majority of the oocytes dies around birth in goat. Thus targeting the early stage that is primordial and primary follicles would be a very good option to increase the ovarian reserves for longer time.

Progress of work during the current reporting year (2019-2020)

(i)Attempt to prolong ovarian life by limiting the death of primordial follicles

Continuation to our last year studies, this year we have confirmed the evolutionary conservation of P63 dependent oocyte death in goat, sheep, pig and chicken (fig1). To identify the novel targets of the P63 we have adopted two strategies (a) Identification of physical and biochemical iteractome by mass spec (b) Identification of new players by computational tools.

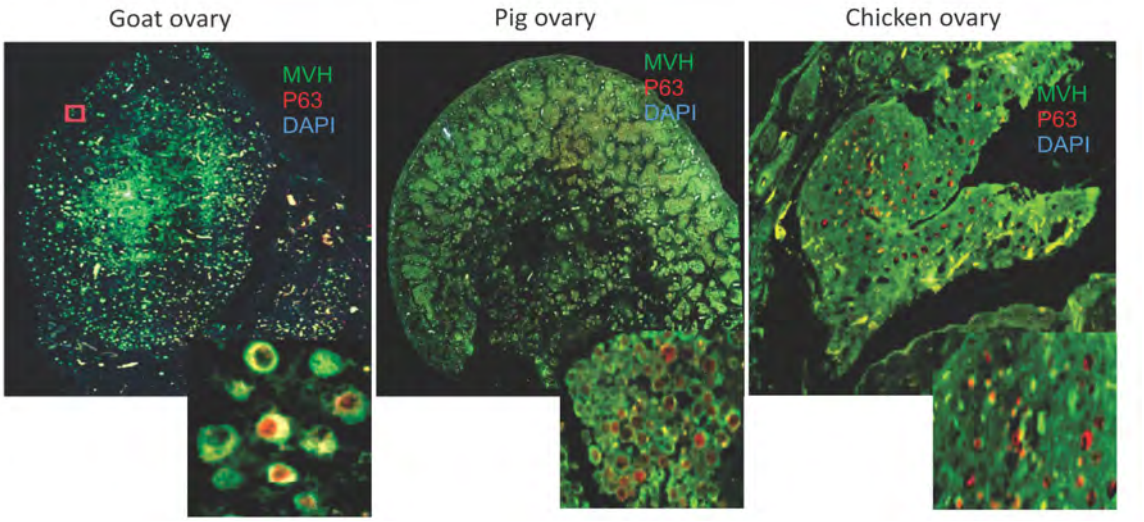


Fig1: *Dynamic localization of P63 in fetal goat, pig and chicken ovaries: The ovarian sections are stained for P63 (red), MVH (green) and DNA (blue).*

(a).Identification of physical and biochemical iteractome by mass spec: We have standardized the method to pulldown P63 using goat ovaries and P63 polyclonal antibody (fig2). In the western blots we could see new P63 interacting proteins. Next we would like to scale up this procedure to get more concentrated P63 to get the interacome using mass spec.

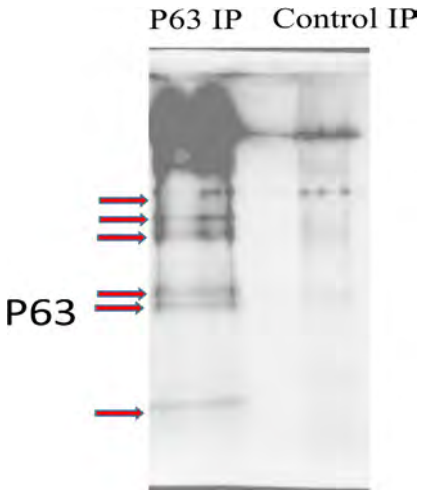


Fig2: *P63 pulldown using goat ovaries. Arrows indicates novel interacting proteins*

(b).Identification of new players by computational tools and their phenotypic analysis:

Using string protein protein interaction network tool, we have targeted two proteins which interact with P63. In our preliminary studies we have screened 20000 natural compounds from Zinc database. Ranked them based on the binding energies with HBD1 and 2. Top and last ranked commercially available compounds were ordered and injected to Balb/c mice.

Four groups of mice each group contains 4 females were injected at the day 10 after birth with 2.5mg/kg of PRL02 and PRL03 (natural compounds) every day up to 21 days. Similar experiment was designed instead of every day we have injected alternate day up to 30 days. Interestingly PRL02 shows striking results with every day and alternate day injections. On 21st day control shows ~2500 total oocytes where as PRL02 injected mouse ovary shows ~5500 (fig 4). This is equal to 10th day mouse follicle numbers indicates that the maximum number of follicles were protected by PRL002. On the other hand PRL03 injected mouse ovary has shown reduction of follicles. Next we reasoned which stage follicles were protected by PRL02, interestingly all the

primary, primordial, secondary, pre antral and antral follicles were protected. These results suggest that the PRL02 could be a potent natural compound which can be used to increase the fecundity of the females.

(b). Identification of new players by computational tools and their phenotypic analysis:

Using string protein protein interaction network tool, we have targeted two proteins which interact with P63. In our preliminary studies we have screened 20000 natural compounds from Zinc database. Ranked them based on the binding energies with HBD1 and 2. Top and last ranked commercially available compounds were ordered and injected to Balb/c mice.

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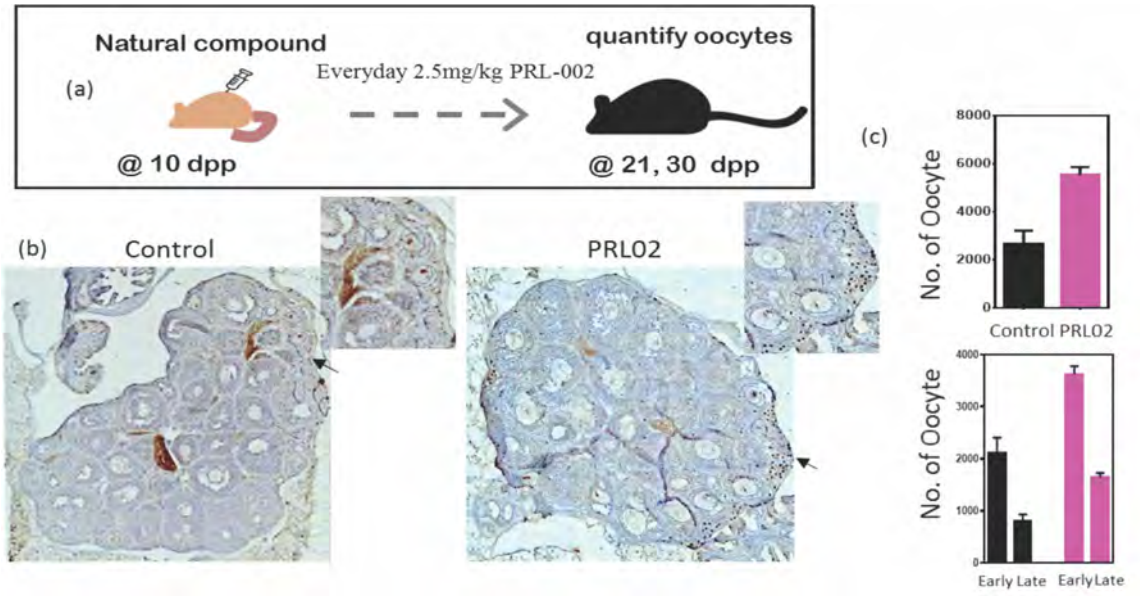


Fig3: *PRL02 protects the oocytes from apoptosis. (a) schematic representation of the experiment (b) Control and treated ovaries with zoom sections stained with P63 in red (c) Top graph is an quantification of oocytes in control and treated, bottom graph is stages of the follicles in control and treated animals. Black arrows shows the zoomed images*

Future Plans:

In future we want check these compounds in livestock species such as goat and sheep to make it field application related and screen the cheaper and naturally available compound to make it farmer friendly. Also we want to confirm the healthy live births from the treated animals.

Publications:

Wei He, **H.B.D.Prasada Rao**, Shangming Tang, Nikhil Bhagwat, Dhananjaya Kulkarni, Yunmei Ma, MariaA.W. Chang, Christie Hall, Junxi Wang, HarrisonS. Manacsa, Christ a Baker, GerrikF. Verhees, Lepakshi Singh, Xiangyu Chen, NancyM. Hollingsworth, Pe tr Cejka, Neil Hunter; Regulated Proteolysis of MutSγ Controls Meiotic Crossing Over. Mol.cell, 2020 Apr 2;78(1):168-183

Lab Photo

Left to right: *Ajay Singh, Lava Kumar, Prasada Rao, Rohit Beniwal and Aradhana Mohanty*

Title: Biopharming Using Farmed Animals and Avenues for Obtaining Sperm with Elite Trait

Nirmalya Ganguli

Principal Investigator: Dr. Nirmalya Ganguli
PhD students:
Kiran Kharatmal

Project Fellows/Trainees:
Ealisha Jain
Dilpreet Kaur
Dewanshu Sharma
Aprajita
Anandhi R. (Since Dec 2019)
Khushboo Agarwal (Till Nov 2019)
Swastika Patra (Till June 2019)

Collaborators:

Dr. Subeer S. Majumdar	NIAB, Hyderabad
Dr. Pankaj Suman	NIAB, Hyderabad
Dr. Syed Faisal	NIAB, Hyderabad
Dr. Neelesh Sharma	SKUAST, Jammu
Dr. Kadirvel Govindasamy	ICAR Centre for NEH Region, Shilong

Theme of Research:

Theme of research of my laboratory is establishing new and easier techniques for generation of transgenic farm animals or animals with targeted somatic genomic modification of mammary epithelial cells by developing new methods for direct transfection of mammary gland for using them as bioreactor for generation of biotherapeutics and nutraceuticals. Germ cell/ Stem Cell transplantation studies to explore avenues for production of sperm with elite characteristics. Generation of transgenic mice to develop mice model of farm animal diseases as well as a system for the study of functional genomics of farm animals.

Objectives:

1. To establish new easier techniques for making transgenic farm animals. To develop new methods for direct transfection of mammary gland. To use these technologies for generating animal bioreactor expressing biotherapeutics in their milk for increasing affordability.
2. To establish germ cell/stem cell transplantation in farm animals to increase production of elite bull sperm.
3. Generation of transgenic mice to develop mice model of farm animal diseases as well as to study farm animal functional genomics.

1. Production of Therapeutic Protein in Milk (bovine FSH and LH, Human Factor8 and Tissue Plasminogen Activator (TPA):

This work is being done in collaboration with Dr. Subeer S. Majumdar. We are taking multidimentional approach to target udder glands of farm animals to convert them as bioreactor. For efficient production of these therapeutic proteins in milk we have to develop, 1) Efficient milk specific expression vector 2)Efficient method for transgenesis in farm animals or alternatively, 3) Method for direct transfection of mammary epithelial cells in udder gland.

We have initiated work to develop a highly efficient milk specific expression vector. For this purpose, we have annotated and isolated β-Lactoglobulin and αS1-casein promoter from genome of Indian river Buffalo.

We are at present in the process of cloning the isolated promoter region in suitable vector. We also hypothesized that along with a strong promoter for expression of exogenous protein an efficient signal

peptide is also required to secreted out the expressed protein out of the cell. We have initiated work to check the strength of signal peptides of various milk protein genes for efficient secretion of exogenous protein in milk. For this we have choosen signal peptide of 5 major milk protein genes (βCasein, αS1-casein, αS2-casein, β-Lactoglobulin and αLactalbumin). We have generated fusion protein construct by clonnig signal peptide of these milk protein genes with luciferase. We are performing luciferase assay to test the efficiency of the signal peptides. We have initiated work of cloning bovine FSH and LH in mammalian expression vector for its characterisation. Bovine pituitary was collected from Slaughter House in Shillong, Meghalaya. Total RNA was isolated from bovine pituitary followed by cDNA synthesis. The cDNA of α-subunit for Bovine FSH and LH was isolated by PCR and cloned under CMV promoter. The β-subunit of FSH and LH was also isolated and cloned under CMV promoter.

We have performed functional validation of these construct invitro, in HEK293 cells, mammary epithelial cells of rabbit and goat **(Fig. 1).**

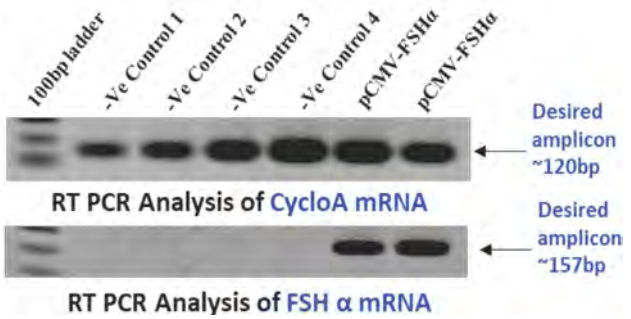
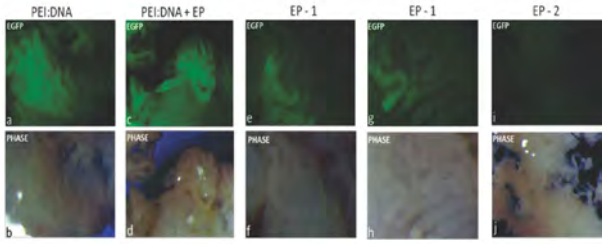


Fig. 1: *Showing RT-PCR analysis of mRNA isolated form pCMV-FSHa transfected cells as compared to untransfected control cells.*

We have also received another project grant in which we will be expressing human Tissue Plasminogen Activator (hTPA) in mammary epithelial cells of goat. The cDNA of human F8 and TPA were procured and validated by restriction digestion. We have cloned hF8 under buffalo βCasein Promoter (buCSN2). We have also cloned the human tissue plasminogen activator (hTPA) under CMVpromoter. We are validating the expression of both these construct in in-vitro as well as in-vivo.

We have also started standardising the testicular transgenesis in Rabbit. It has been proved that rabbit suits better as bioreactor for producing biotherapeutics in the milk. We performed testicular ex-vivo electroporation of rabbit testis followed by in-vitro culture of the tubule of the electroporated testis. We observed expression of EGFP in the cultured tubule in various electroporation parameters, when transgene cassette contained egfp as a marker gene. We also tested efficacy of nano particle mediated delivery of transgene in the germ cells. We developed DNA conjugated polyethyleneimine (PEI) nano particle. This PEI:DNA nano particle was then used for delivery of transgene in the germ cells. We observed EGFP expression in the PEI



DNA treated testis also **(Fig. 2).**

Fig. 2: *Showing expression of EGFP in the exvivo electroporated tubule isolated form rabbit testis.*

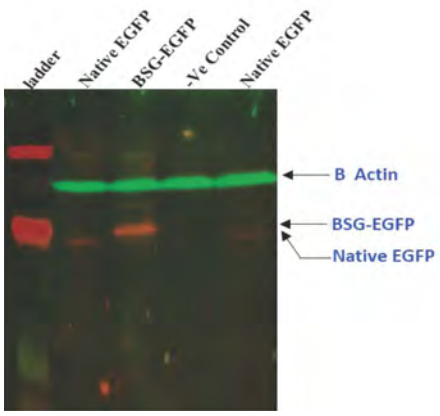
We also performed external electroporation of rabbit testis for delivery of transgene in the germ cells followed by generation of transgenic sperm. We performed immuno histochemical analysis of the electroporated testis which revealed expression EGFP, present in the germ cells of the electroporated testis.

We are working for developing an easy and robust method of farm animal transgenesis. We are trying to standardise easy testicular transgenesis in farm animals. In this direction we have initiated the work of testicular transgenesis in goat and pig by transfecting the goat and pig germ cells through electroporation.

In the purview of the difficulties in transfecting maximum number of germ cells in the testis of large animal which eventually result in poor number of transgene bearing sperm in the ejaculate, we are designing and validating the transgene construct which will help in sorting out of transgene bearing sperms. We have fused the EGFP with signal peptide and transmembrane domain of the sperm surface protein Basigin (BSG-EGFP) and cloned it under CMV promoter.

Such fusion protein will help in anchoring EGFP in the surface of the sperm tail membrane, facilitating the sorting out of such sperm from the ejaculate. These positive sperm may then be used for assisted reproductive technique for generation of transgenic pups. We have designed the construct and performed functional characterisation of this construct invitro in HEK cells.

The BSG-EGFP fusion protein construct was transfected in the HEK293 cells which showed localised expression of EGFP in the cell membrane. The western blot analysis of the protein isolated from BSG-EGFP transfected cells detected EGFP at higher molecular weight as compared to native EGFP, due to addition of BSG signal paptide (Fig. 3). Microscopic analysis of non permeabilised cells, specifically detected EGFP localisation on the outer surface of the cell membrane. We are at present



validating the functionality of this construct in-vivo.

Fig. 3: *Image showing Western Blot analysis of BSG-EGFP fusion protein as compared to native EGFP.*

For direct transfection of udder glands, we have established pilot scale cultutre of Sendai Virus in allantoic fluid of embryonated chicken eggs followed by development of Virosome from it. We have also initiated work of developing various nano particle for transfecting the mammary epithelial cells invivo. Among all non-viral transfecting agents, chitosan (CS) and PEI is widely used for their ability to transfect mammalian cells. We have generated chitosan and PEI nano particle conjugated with DNA to test their efficacy for transfecting the mammary epithelial cells

2. Germ Cell Transplantation in Farm Animals:

We are establishing the culture of germ cells from goat and buffalo along with easy method of evacuation of testis from germ cells in large animals without nonspecific cytotoxic effect. There is method available for evacuation of testis but this often creates immune susceptibility in animal leading to deaths sometimes therefore generation of restriction for using in farm animals. Development of a safe method for germ cell depletion in farm animals is urgently needed to extrapolate germ cell transplantation in farm animals with full potential. We have successfully established the culture of mice testicular stem cells/germ cells on monolyer of mice embryonic fibroblast (MEF). We have obtained colonies of stem cells which was confirmed by immuno cyto chemistry analysis of various germ cells specific marker. We have also established isolation and culture of spermatogonial stem cells/germ cells from goat testis which represent characteristic grape like morphology of the stem cells colony. We are also attempting to isolate and culture the germ cells from pig testis. At present we are performing the immuno cyto chemistry of cultured stem cells colony with various germ cell specific markers to confirm their identity. In mice, previously we have established that direct testicular delivery of the cytotoxic drug busulfan evacuate the testis from germ cells by passing the non specific cytotoxic effect on the other stemcell population of the body. We have also initiated the recipient preparation process for transplantation of the germ cells in pig.

3. Genetic Basis of Udder Gland Development:

We aim to decipher the biological pathways and mechanisms that govern mammary gland development and lactation which is commercially important. We wish to decode the roles of various genes and regulatory RNAs (miRNA, long noncoding RNA) involved in mammary gland development and lactional output. Using various softwares available, we have establishd the pipeline for analysing the data obtained from RNA seq. As recommended by the SAC we are at present focusing on performing sequencing of total RNA from Indian breed of goat.

We have also standardized the invitro lactogenic induction process and obtained upregulation in the mRNA production of lactogenically regulated genes (CSN2, CSN1 etc) by RT PCR and Immuno cyto chemistry analysis.

Lab Photo

Left to right: *Dilpreet Kaur, Dewanshu Sharma, Nirmalya Ganguli, Ealisha Jain, Anandhi R.*

Title: Aptamer and antibody based point-of-care diagnostics for better animal production and health

Pankaj Suman

Principal Investigator: Dr. Pankaj Suman
PhD Students:
Pankaj Kumar
T. Yathirajarao (Since July 2018)
Project Personals/Trainees:
Komal Birader
Sherin Kaul
Anil Babu Korada (Since Jan 2020)
Jeanie Alice Barla (Till July 2019)
Devika Nagar (Till July 2019)
Sai Keerthana L (Till January 2020)
Sharanya K (Till January 2020)
Pooja Kushwaha (Till January 2020)
Sai Muni Yasaswi K (Since January 2020)
Sowmya T (Since January 2020)

Collaborators:

Dr. Abhinav Shrestha	Dhiti Life Sciences, Delhi
Dr. Pranjal Chandra	IIT BHU, Varanasi
Dr. Nirmalya Ganguli	NIAB Hyderabad
Dr. Saptarshi Majumdar	IIT Hyderabad
Dr. Chandrashekhar Singh	IIT Hyderabad

Theme of Research

Our laboratory is working on to devise strategies to improve animal production and health through biomarker discovery and development of aptamer/ antibody based affordable, field applicable, point-of-care diagnostics. In addition, we have also initiated working on to improve the digestibility of roughages through manipulation of enzyme or enzymatic pathways of ruminal bacteria and fungi.

Aptamer based lateral flow device for detection of heat or estrous in buffalo

Optimal fertility in livestock is most important factor for the success of livestock industry. Silent heat leading to failure in conception is the leading cause of reproductive insufficiency in buffalos. To address the problems associated with detection of oestrous, we aim of develop aptamer based point-of-care diagnostic platform to detect progesterone (as a biomarker for oestrous detection) level in milk. Aptamers are selected from the single stranded DNA library following Systematic evolution of ligands by exponential enrichment (SELEX) approach. For getting better aptamers against P4, total 20 cycle of SELEX has been performed by incorporating counter-SELEX using milk and serum. We have obtained 241 sequences, out of that 16 have been obtained in multiple copies that formed a basis for screening of the aptamers.

Screening of aptamers for progesterone (P4)

Circular dichorism (CD) was performed to know if there is any structural change in the conformation of oligonucleotides upon binding with P4. In this, we observed that the aptamers showed a conformation characteristic for B form of DNA as it invariably showed a positive peak at about 260-280 nm and a negative peak at around 245 nm. Upon interaction with the P4, a shift in ellipticity has been observed

in 4 aptamers (Fig 1). We are further characterizing these aptamers for their ability to recognize the target through aptamer based lateral flow assay.

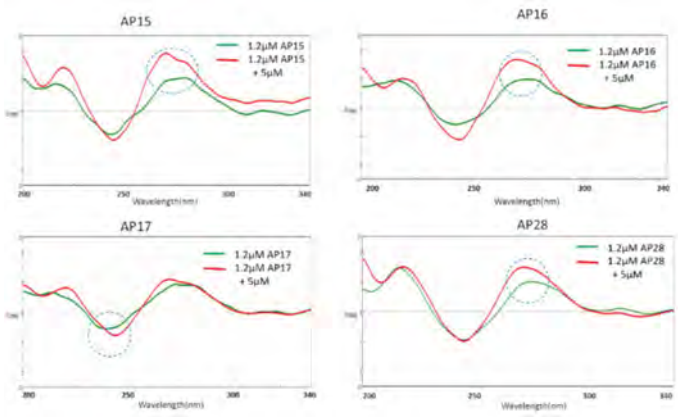


Fig 1. **Circular dichorism (CD) spectroscopy to show the interaction of aptamer with P4.** *Aptamer (1.2 μM) was incubated with progesterone (5 μM) at room temperature for 10 minutes and shift in ellipticity and peak wavelength was recorded.*

Development of point-of-care diagnostics for snake venom detection upon snake bite in farm animals

India accounts for the highest number of death of human being worldwide due to snake bite. Envenomation has not spared the livestock but due to underreporting of the incidences of snake bites; proper data is not available. Polyvalent antivenoms therapies are now being reported to be ineffective as it provides protection in only 60-70% of the cases. In addition, it has potential side effects. So, there is an increasing need to develop monovalent antivenom therapy for which identification of the snake who has bitten the individual, becomes very crucial. Previous year, we initiated working on to express the venom specific recombinant proteins in prokaryotic expression system. For that, two unique proteins, one each from *Naja naja* (NN-1) and Bungarus caerulus (BC-1) showing no sequence similarity with venom from other poisonous snakes and vertebrates were expressed as recombinant proteins in *E. coli*.

Immunization of mouse with the recombinant fusion proteins

Three female BALB/c mice (M/S Teena labs, Hyderabad, India) of 6-10 week old were immunized subcutaneously with 20 μg of recombinant rNN-1 protein. After three weeks, four additional boosters at an interval of two weeks were given through intraperitoneal route using half the amount of rNN-1. Sera samples were collected and tested for immune-reactivity with rNN-1 using ELISA following standard protocol. The mouse showing highest antibody titer was boosted through intravenous route for three consecutive days before fusion of splenocytes with myeloma cells.

Generation of Hybridomas and its selection

After the boosters through the intravenous route, mouse was sacrificed and spleen was removed aseptically and splenocytes were collected from the spleen. Fusion was done by mixing them with exponentially growing SP2/O mouse myeloma cells in 2:1 ratio using 50% PEG. Following this, cells were seeded in four 24 well plates having the feeder layer and selection of hybridomas was done by growing them in HAT media for 10 days. After 10 days, the clones were screened by ELISA for the production of antibodies against recombinant protein and against the whole venom. The positive clones were selected and limiting dilution was performed. The clonal selection was done after checking the cross-reactivity with other venoms. Clone 1.1 was selected as a single hybrid clone secreting antibody against rNN-1. Antibody was purified from the culture supernatant using protein-G column. Purified antibody was again checked for its reactivity towards different antigens and it showed strong reactivity with the NN-1, peptide II of NN1, cobra and krait venom and no reactivity with vipers**.**

Characterization of binding affinity of the monoclonal antibody

For a typical MST experiment, one fluorescent binding partner and one non-fluorescent binding partner (the ligand) is required. In this assay, rNN-1 was conjugated to NT-647 dye through amine coupling using NHS labelling protocol. After labelling, its concentration was kept constant (10 μM), while the concentration of the unlabelled antibody was varied. MST analysis was performed using the Monolith NT.115. The antibody showed a dissociation constant of ~1.4 nM with a signal to noise ratio of 16.9. Further, SPR measurement was performed using monoclonal antibody1.1 for binding affinity measurement with four different analytes rNN-1, peptide II of rNN-1, cobra venom and krait venom at different concentrations. The dissociation constants of peptide II, NN-1, cobra and krait venoms with monoclonal antibody clone 1.1 was 7.37 nM, 31 nM, 3.11 μM and 0.149 mM respectively.

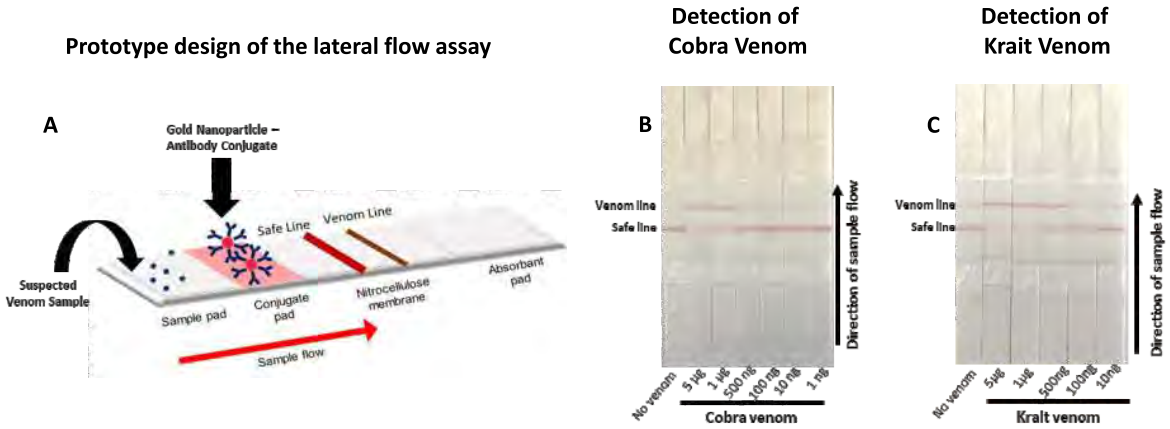


Fig 2. *Development of lateral flow assay for detection of Cobra and Krait Venom. Panel A: Schematic representation of the lateral flow strip. Panel B: Sensitivity testing of the lateral flow strips for detection of cobra venom. Panel C: Sensitivity testing of the lateral flow strips for detection of krait venom.*

Development of lateral flow assay for detection of cobra venom

The schematic diagram of the strip fabrication is shown in Fig 2 (Panel A). It is based on the competition for the antibody to bind with the venom (in sample) and the peptide II (10 µg) of rNN-1 (at test line). Regardless of the presence of NN-1 in the sample, excess of the Antibody–AuNP would definitely hybridize with the anti-mouse IgG antibody at control line (Fig 2, Panel B and C). The detection of cobra venom was carried out by applying varying amount of cobra venom to the sample pad. Visual detection limit of cobra and krait venom was found to be 0.01 µg and 0.1 µg respectively.

3. Aptamer based affordable diagnostics for detection of antibiotics in milk and assessment of udder health

Antibiotics are widely used throughout the world, across a diverse array of extensive and intensive livestock management practices to safeguard the health and welfare of livestock; to improve the growth and productive performance; to lower the incidence of disease; to reduce morbidity and mortality; also for the production of abundant quantities of high-quality and low-cost food for human consumption. In the dairy husbandry milk producers essentially rely on the use of antibiotics and medicinal drugs to treat mastitis and various infectious diseases. As per the summary reports of Food and Drug Administration (US Food & Drug Administration, 2014) sales and distribution of antimicrobials approved for use in food-producing animals for the year 2012 was approximately 14.8 million kilograms. Of these; Tetracyclines (TCs) accounted for 40% of total sales; followed by Ionophores (31%), Penicillins (7%), Macrolides (4%), Sulfonamides (3%), Aminoglycosides (2%), and other drug classes (13%). So, to develop an affordable point-of-care diagnostic system that has the potential to become field applicable, we have initiated the work to develop an aptamer based lateral flow assay to detect oxytetracycline in milk.

For the construction of a lateral flow assay system to detect oxytetracycline (OTC) in milk, a competitive lateral flow assay platform has been designed. In this, the sample containing the OTC will pass through the lateral flow strip and interact with the aptamer (specific for OTC) conjugated to AuNP on the conjugate pad. Following this, the sample containing free AuNP-aptamer conjugate as well as OTC bound AuNP-aptamer conjugate will move along the nitrocellulose membrane. Free AuNP-aptamer conjugate will bind to the OTC immobilized at the test line while those crossing the line will bind with the control line (having poly T oligonucleotide complementary to the poly A overhang in the aptamer). In the absence of OTC in the sample, AuNP-aptamer conjugate will get sequestered by OTC present on the test line. In the presence of OTC in the sample, these will preferentially bind with the AuNP-aptamer conjugate at the conjugate pad and that's why they will not get recognized at the test line (having OTC) but will get sequestered at the control line due to binding with complementary (Poly T- Poly A) DNA sequence. The appearance of a single band on the lateral flow membrane shows the absence of antibiotic and appearance of two bands shows the presence of antibiotic in the sample. We have tested the assay by spiking the milk samples where we were able to detect the antibiotic till 50 ppb (permissible limit being 100 ppb assigned by FSSAI). We may further be

working on development of similar kind of assay for other antibiotic detection.

Patents:

Pankaj Suman, T Yathirajarao, Pankaj Kumar. "A method for detection of subclinical and clinical mastitis and assessment of microbial quality of milk using non-functionalized iron oxide nanoparticles;

Indian Patent application number- 201941044822; Date of filing: November 5, 2019.

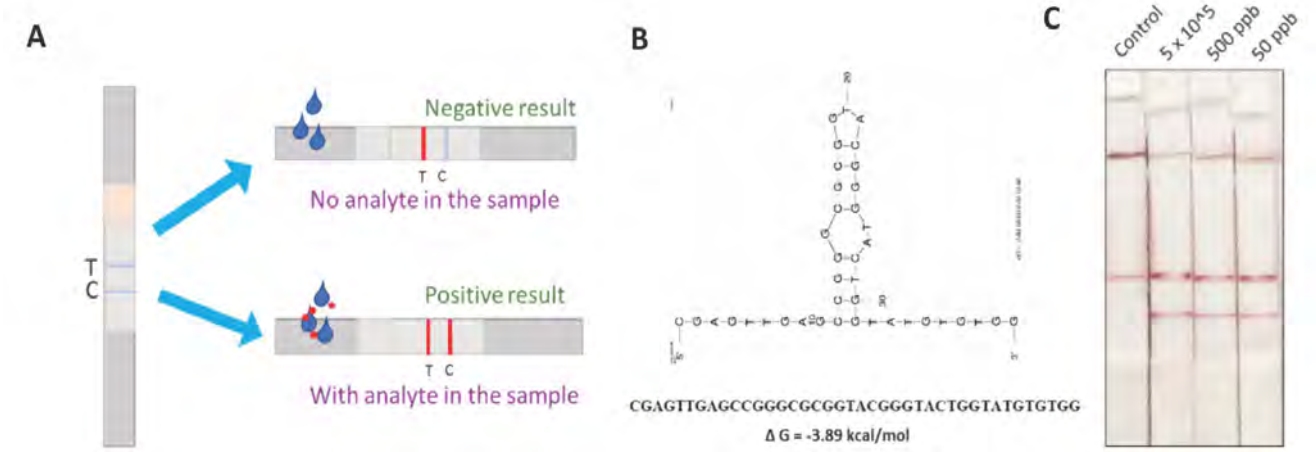
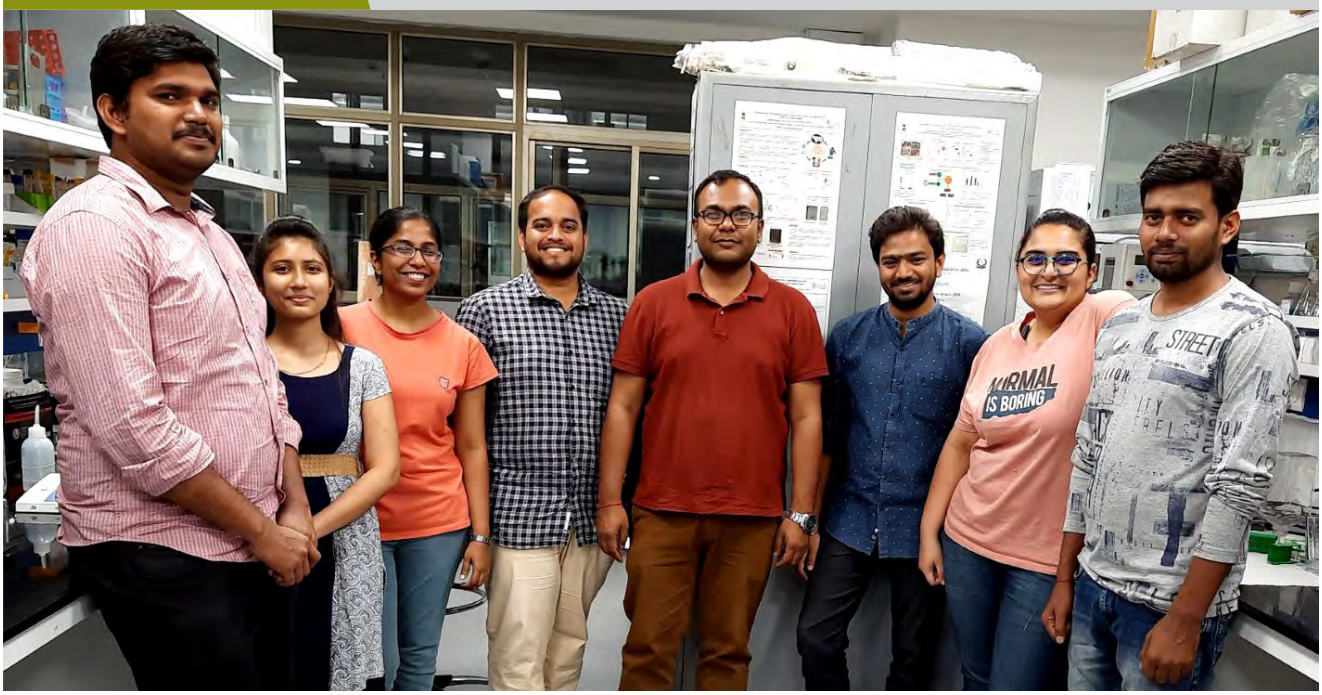


Fig 3. *Format of lateral flow assay and working principle for oxytetracycline detection in milk. Panel A: Aptamer based Lateral Flow Assay; test line (T): OTC-PLA2 conjugate; control line (C): Complementary aptamer streptavidin conjugate. Panel B: Aptamer that is conjugated with GNPs on conjugate pad. Panel C: Detection of oxytetracycline in spiked milk sample.*

The Lab Photo



Left to right: *Anil K, Sowmya T, Komal Birader, Yathirajarao T, Pankaj Suman, Sai Muni Yasaswi, Sherin kaul, Pankaj Kumar*

Research Projects

B. Animal Health

Title: **Microbial Pathobiology and One Health**

Nagendra R. Hegde

Principal Investigator: **Dr. Nagendra R. Hegde**

PhD students:
Priya Gupta
P. Jasmeen
Sashikanta Parida

Project Personnel:
Madhavi Annamanedi, DBT, RA
K. Pavan Asrith, Project Fellow
Charanpreet Kaur, RA
Sathi NN Mallick, RA
Madhuranjana Gargi, SRF

Collaborators:
SG Ramachandra, IISc, Bangalore
Shrikrishna Isloor, KVAFSU, Bangalore
J Rajendhran, MKU, Madurai
P Aravindh Babu, TANUVAS, Chennai
SV Rama Rao & SS Paul, ICAR-DPR, Hyderabad
TR Gopala Krishna Murthy, A Natarajan, V Gowthaman, TANUVAS, Namakkal
Jyoti Joshi, Amity University, Noida, UP
Nicola Williams & others, U of Liverpool, UK
Jennifer Cole, Royal Holloway U London, UK
Alison Prendiville, U of the Arts London, UK
Javier Guitian, Royal Veterinary College, UK
Dominic Moran, U of Edinburgh, UK
Kalyani Putty, PVNRTSVU, Hyderabad
Debasis Nayak, IIT-Indore

Theme and Objectives of Research

Our group works on the broad area of microbial pathobiology, including genomic characterization of microbes, host-microbe interactions, virulence factors and mechanisms, methods of diagnosis, treatment and prevention, and consequences of livestock and poultry production practices to public health. In the current year, we were engaged in (a) understanding the genetic diversity of bovine mastitis-associated staphylococci, and exploring inhibition of biofilm formation to mitigate antibiotic use, (b) developing serological assays for the detection of subclinical pathogens of mice and rats for their health monitoring, and (c) understanding the drivers of antimicrobial resistance in poultry with the possibility of suggesting interventions on rational use of antibiotics. In addition, we have initiated studies on the biology of bovine ephemeral fever virus.

Molecular fingerprinting and genomics of bovine mastitis-associated staphylococci, and explorations on potential anti-biofilm agents

Mastitis is an important disease of lactating animals. Staphylococci are the major cause of subclinical, chronic and recurrent mastitis. Antibiotics are used to treat mastitis, but frequently without rationale. Understanding the diversity of staphylococci can help better devise control and intervention strategies for mastitis besides contributing to a repository of characterized strains.

Led by our group, and in collaboration with KVAFSU and MKU, a total of 236 *S. aureus* isolates obtained from bovine and bubaline mastitis were subjected to various analyses. Disc diffusion studies revealed that 27.5% of the isolates were methicillin resistant. Typing revealed (a) 32 different groups of PFGE patterns, with nine pulsotypes (Fig. 1), (b) 37 different *spa* types, with t359, t7867 and t4522 encompassing 45% of the total, and (c) 38 different sequence types (STs), with ST-2454 and ST-2459 encompassing 44% of the isolates (Fig. 2). However, only six clonal complexes (CC) prevailed,

with the predominance (>90%) of CC8 and CC97, suggesting preponderance of certain clones in different states (Fig. 2), and yet the existence of inter-related diversity. Out of 83 the isolates tested, 15 carried *mecA* and three isolates belonged to SCC *mec* type V (data not shown). Toxin profiles suggested pathogenic traits of *S. aureus* isolates (54% *hlg*, 25% *tsst* and 43% *pvl* positive; not shown), predominantly in isolates from Karnataka, but genomic data mining did not identify any specific determinant for causation of mastitis (data not shown). In addition, studies have also been

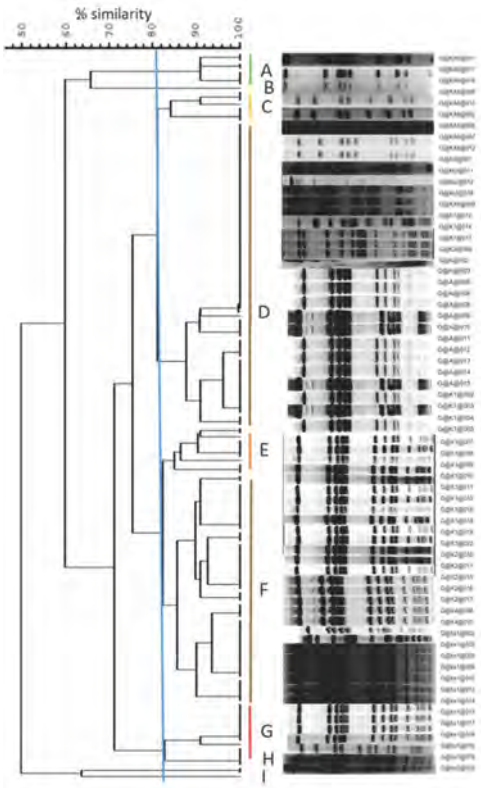


Fig 1. *Pulsotype analysis of S. aureus isolates. PFGE was performed using SmaI enzyme and the data was analyesd using BioNumerics sowftware.*

performed by KVAFSU on random amplification of DNA (RAPD) analysis of *S. chromogenes,* and 12 distinct types were observed among 37 isolates (data not shown).

Genome sequencing was undertaken by MKU, and 51 isolates of staphylococci were selected based on the host species (bovine, bubaline), type of setting (rural/ urban; organized farm/unorganized house-hold), geographic location (taluk, district, state), available genotype (*Spa*, MLST, capsular polysaccharide), clinical and diagnostic picture (somatic cell count, California mastitis test, clinical case) and species of the bacteria (*S. aureus* and Coagulase-negetive *staphylococci*). Analysis of the data is on-going.

We have now begun to examine the ability of *S. aureus* isolates to form biofilm. Towards this, we initially performed biofilm formation assays on 100 isolates. The results indicated that in media (brain heart infusion) containing 0.1% or 1% glucose or lactose, different isolates exhibited differing abilities to form biofilm (data not shown). The effect of biofilm formation on the ability of select isolates to resist antibiotic treatment *in-vitro* is being carried out through minimum inhibitory concentration (MIC) studies.

Development of diagnostics for health monitoring of laboratory animals

Mice and rats are widely used in research to understand basic biology and for modeling diseases, as well as for pre-clinical and regulatory toxicology studies. Subclinical infection of these animals can compromise the outcome of experiments, but health monitoring is rarely performed in India. Furthermore, regulatory guidelines for preclinical toxicology testing stress that such animals be free from specific pathogens. It is therefore necessary to monitor the microbiological health status of experimental animals. In collaboration with IISc and TANUVAS, we are developing ELISA for seromonitoring five different pathogens in mice and rats, based on our earlier epidemiological studies. The project is expected to contribute to the development of an indigenous kit for monitoring the subclinical infection status of rats and mice used for experimentation.

During the previous year, we had predicted 23 linear, surface-exposed epitopes from different proteins of sialodacryoadenitis virus (SDAV), Kilham's rat virus (KRV), minute virus of mice (MVM) and mouse hepatitis virus (MHV) and performed peptide ELISA. We identified one dominant epitope in each of four different pathogens.

During this year, for developing the recombinant protein-based ELISA for MVM, KRV, MHV and rat Coronavirus (RCV), cloning and expression was initiated. For antigenic regions or full-length proteins of MVM and KRV, prokaryotic expression system was used. Various constructs were subjected to protein expression and purification as described (Fig. 3). Purified proteins were used in indirect ELISA against sera known to be positive or negative as assessed by a commercial kit. Following standardization, proteins were used at 0.5-1.0 µg per well for coating and sera were diluted 1:50 to 1:100. Results showed that our ELISA detected more samples than the commercial ELISA kit (Fig. 4).

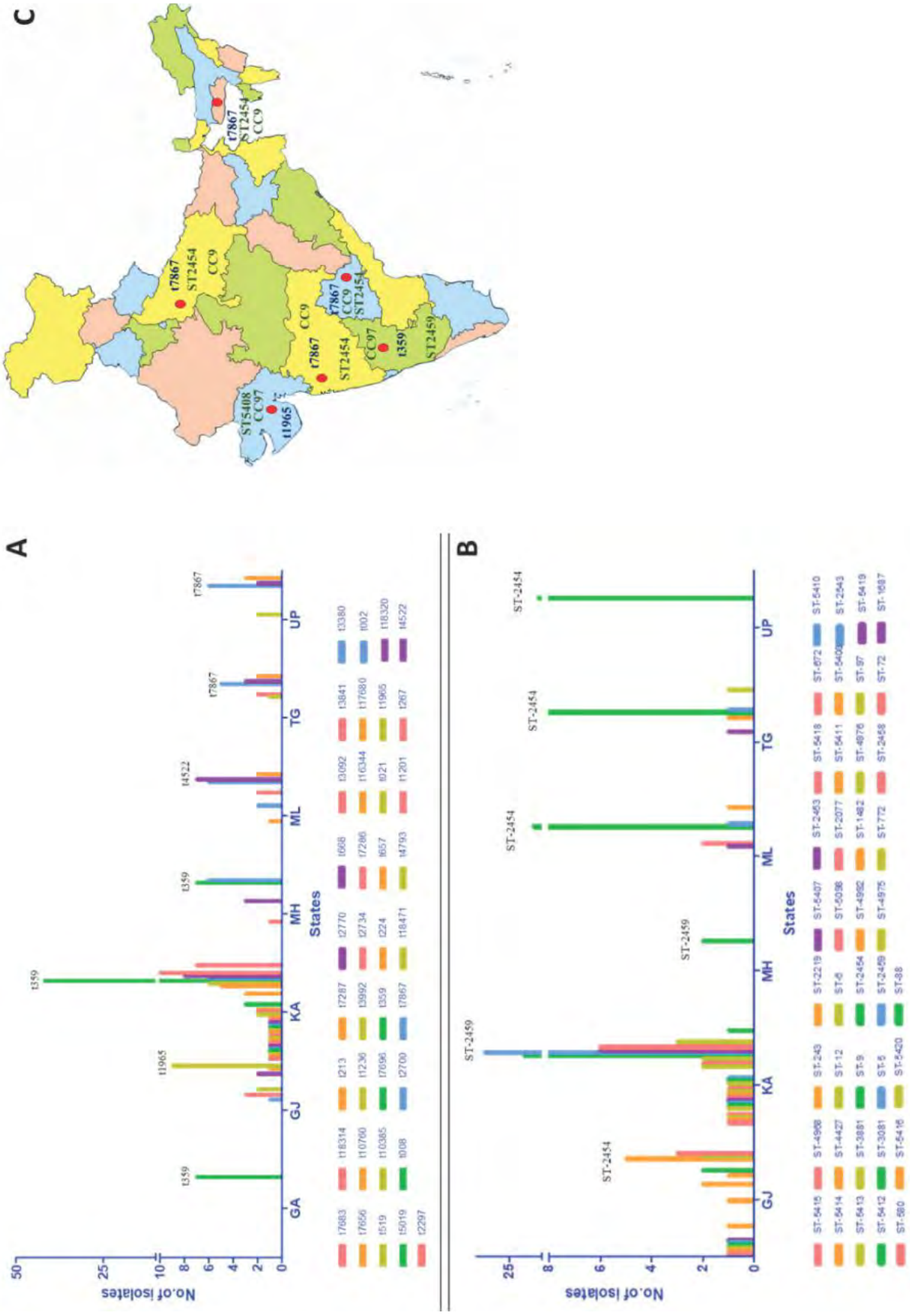


Figure 2. Graphical representation of sap type (panel A) and multi-locus sequence type (ST panel B) and clonal complex (CC, panel C) frequency in different states. *The most frequent type in each state is labelled in the graph, and stated in the map.*

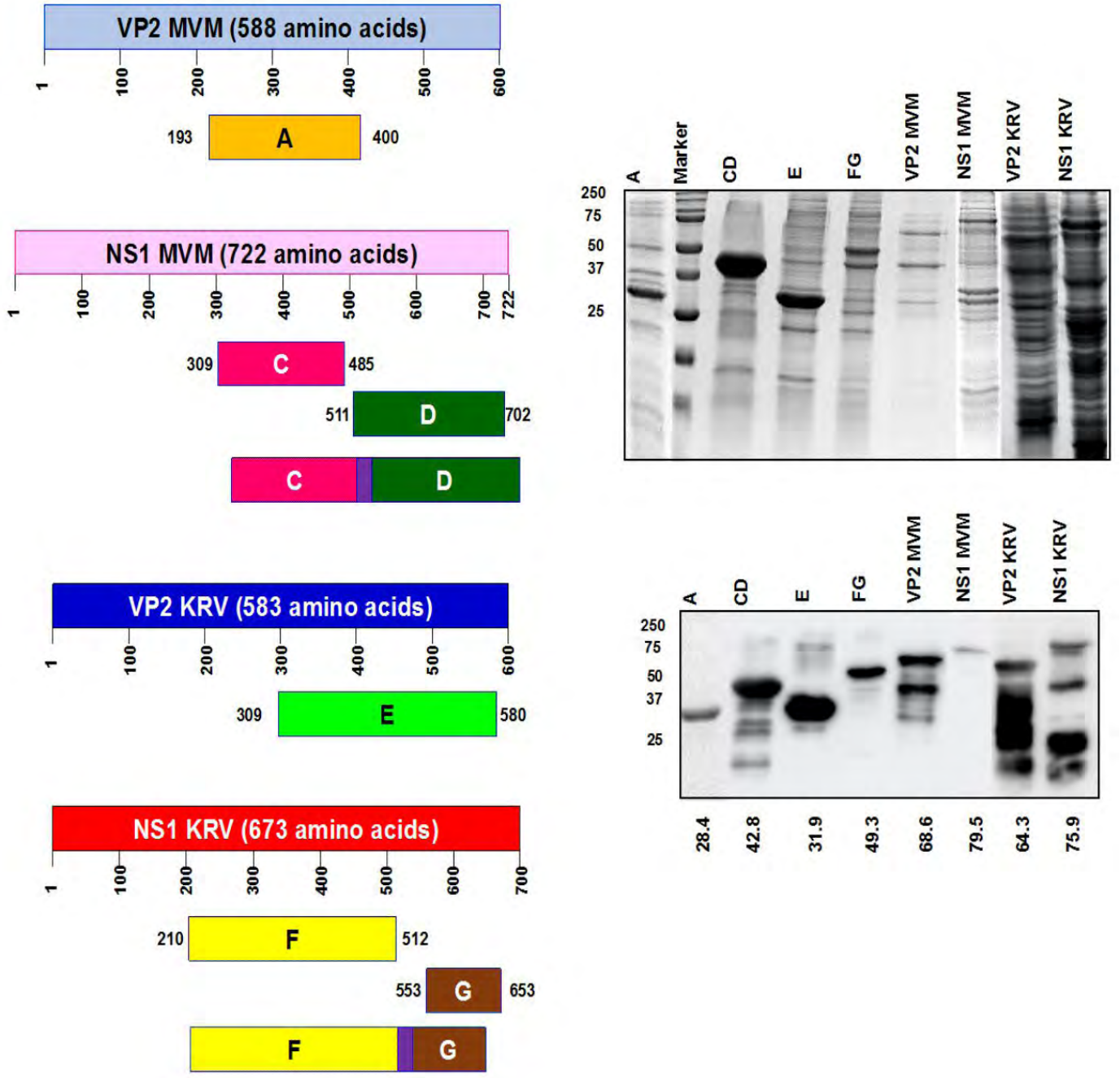
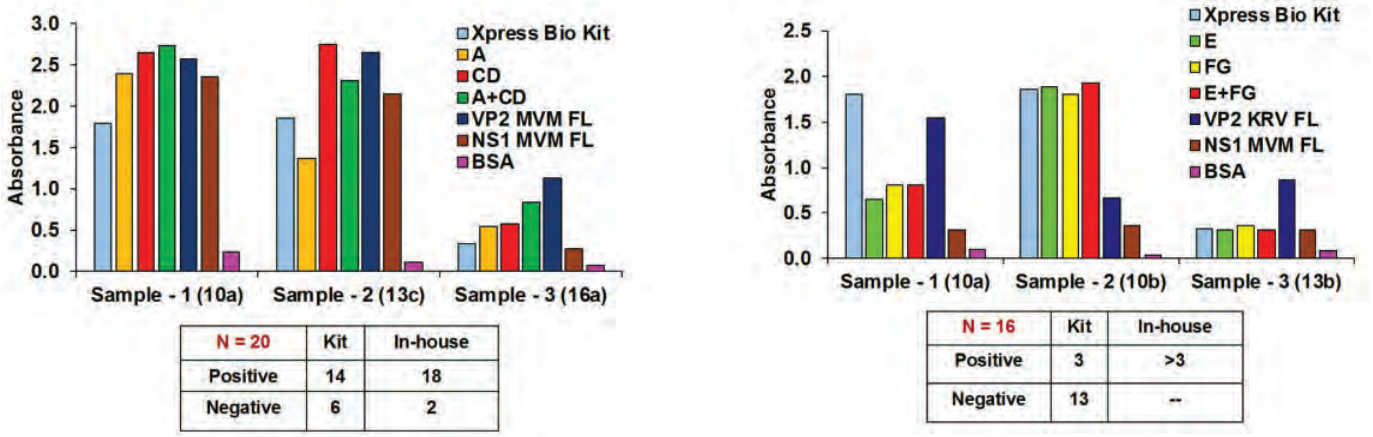


Fig 3. *Expression of recombinant proteins. Various constructs were generated as illustrated in the left panel for VP2 and NS1 proteins of both MVM and KRV. Both full-length as well as fragments (either singly or joined through a linker) predicted through immunoinformatics were generated. Proteins were expressed by IPTG induction in bacterial system and purified by immuobilized metal affinity chromatography (top right panel) followed by HPLC (bottom right panel). The expression was verified by western blotting using anti-His antibodies (right panels), and the expected size of the respective proteins is provided below the blot.*



N = 20	Kit	In-house
Positive	14	18
Negative	6	2

N = 16	Kit	In-house
Positive	3	>3
Negative	13	--

Fig 4. *Results of ELISA using recombinant proteins against known positive/negative sera. Wells were coated with 500-1000 ng per well of protein, blocked and incubated with 1:100 dilution of sera. Washed strips were incubated with anti-species-HRP conjugate, and the bound antibodies were detected using TMB and measuring absorbance at 450 nm. Left, ELISA for MVM. Right, ELISA for KRV.The tables below the graphs show comparison of the in-house ELISA against results for the same sera using commercial kit.*

Drivers of antimicrobial resistance (AMR) in poultry in India

AMR is a serious public health concern. Agricultural and animal husbandry practices, including the use of growth promoters are factors which have been identified as one of the contributors to AMR. AMR is known to be a problem in poultry, but systematic and comprehensive studies to understand the consequences of the use of antimicrobials and the implications of withdrawal or the use of alternatives are lacking. Through this project, we intend to understand the drivers of AMR and design intervention strategies through a multi-disciplinary approach encompassing social science, anthropology, microbiology, nutrition, economics and risk assessment.

In this project, our group is tasked with carrying out part of the activities relating to the flow of AMR genes and the risk of horizontal transfer. Towards this, we have: (a) produced a document with details on antibiotics, classification, chemical structure, mechanisms of action, resistance genes etc. (b) obtained training in microbiological, molecular biological and social science research methodologies such as participatory research (including interviews, focus group discussions), rapid ethnography (including farm visits, observations, transect walks, sketching out the activities) and co-design methodologies, and (c) standardized conventional, multiplex and real-time PCR in our laboratory.

In addition, in consultation with all the other investigators, a sampling frame has been drawn, which includes time-points and types of samples. A pilot run has been carried out where various samples have been collected and bacteria (*E. coli, Salmonella*) isolated; these are being characterized as per the protocols drawn up.

Publications:

1. M Jacquot, PP Rao, S Yadav, K Nomikou, S Maan, YK Jyothi, N Reddy, K Putty, D Hemadri, KP Singh, NS Maan, **NR Hegde**, P Mertens, R Biek. Contrasting selective patterns across the segmented genome of bluetongue virus in a global reassortment hotspot. Virus Evolution 5(2):vez027.
2. P Sheela, S Isloor, D Rathnamma, BM Veeregowda, BE Shambulingappa, ML Satyanarayana, S Sundareshan, **NR Hegde**. 2019. Characterization by spa typing of *Staphylococcus aureus* isolates originating from bovine and bubaline mastitis in southern India. Indian J Comp MicrobiolImmunol Infect Dis 40(1):21-30.

The Lab Photo

Left to right: Sathi Mallick, Madhavi Annamanedi, Pavan Asrith, Nagendra Hegde, Pagala Jasmeen, Madhuranjana Gargi and Priya Gupta (not in pictire: Charanpreet Kaur)

Title: Understanding the virulence mechanisms of the zoonotic pathogen, Brucella and development of improved vaccines and diagnostic assays for animal and human brucellosis.

Girish K Radhakrishnan

Principal Investigator: Dr. Girish K Radhakrishnan

PhD Students:
Padmaja Jakka
Prachita Nandini
Sushreerekha Mallik
Swapna Namani
Varadendra Mazumdar
Binita Roy

Project Personnel:
Swetha Sankati (Till Jan 2020)
Kiranmai Joshi (Since Oct 2018)
Sayanna Are (Since Jan 2020)

Theme and Objectives of Research:-

Brucellosis is an infectious disease caused by bacteria of the genus Brucella that affects humans as well as domestic and wild animals, leading to significant impact on public health and livestock industry. Brucellosis accounts for huge loss to the livestock sector and poses a serious threat to public health. Brucellosis in livestock and its impact on public health causes an annual loss of Rs. 22,800 crores in India. There is no human vaccine available for brucellosis and the existing animal vaccines have many drawbacks. Minimal information is available on the virulence factors that enable Brucella to survive and replicate in the host. Overall objectives of my research projects are (i) To develop improved vaccines and diagnostic assays for animal and human brucellosis; (ii) To understand the mechanisms by which Brucella modulate the host immune responses; (iii) To characterize the host factors that support the invasion and intracellular multiplication of Brucella.

To develop novel vaccines and diagnostic assays for animal and human brucellosis

Early detection and control of brucellosis in livestock is important for controlling the disease in humans. The diagnosis of Brucella by culture is difficult because of its fastidious nature, slow growth and potential hazard to the laboratory personnel. The existing sero-diagnostic assays for brucellosis have many disadvantages such as poor sensitivity, cross-reactivity and lack of "Differentiating Infected from Vaccinated Animals" (DIVA) capability. Towards developing improved serodiagnostic assays and vaccines for brucellosis, we identified several immunodominant protein antigens of Brucella using a high-throughput immunoprobing of a Brucella protein microarray. Subsequently, we developed an indirect ELISA (iELISA) based on one of the immunodominant proteins (BM5), followed by its evaluation. Towards this objective, the serum samples were collected/obtained from cattle, S19-vaccinated cattle and humans. Next, the sera were screened using BM5 iELISA or validated commercially available iELISA, followed by evaluating the sensitivity and

specificity of the BM5-based iELISA (Table 1). The BM5-based iELISA exhibited high sensitivity and specificity.

Estimates	Values
Sensitivity (%)	100 (86.28 -100)
Specificity (%)	99.49 (97.19 – 99.99)

Table: Comparison of BM5 iELISA with Novalisa (NovaTec, Germany) using human serum samples.

Next, we evaluated the DIVA capability of BM5-based iELISA. The serum samples were collected from cattle at 21, 45 and 90 days post-S19 vaccination, followed by screening the samples using BM5 iELISA. The OD values of the known positive, negative and S19 vaccinated serum samples were estimated. The cut-off was derived by calculating the mean OD of all the negative samples and the standard deviation from the mean value.

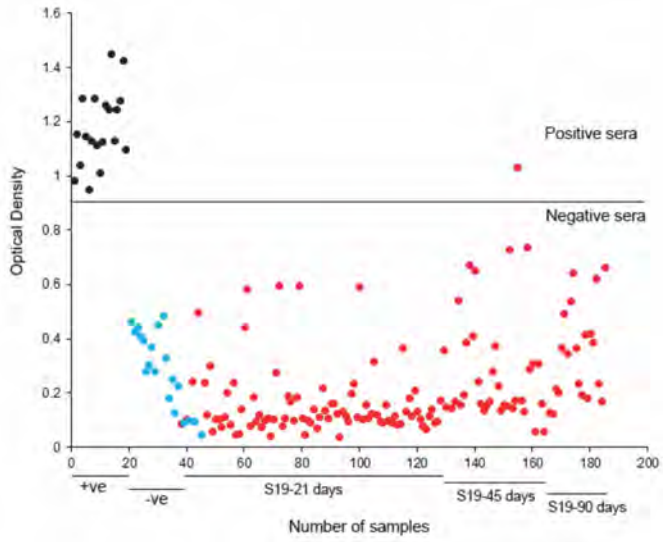


Figure 1. *Dot plot showing OD values of sera from brucellosis positive, negative or S19 vaccinated cattle. (Black: +ve serum; Blue: -ve serum; Red: S19 vaccinated serum).*

The serum samples from S19-vaccinated cattle showed the OD similar to that of negative controls (Fig. 1). The assay clearly indicates that the BM5-based iELISA could differentiate S19-vaccinated from naturally infected cattle.

To understand the mechanisms by which Brucella modulate the host immune responses.

Toll-like receptors (TLRs) are crucial components of the innate immune system that recognize conserved microbial components and trigger anti-microbial responses. The interaction between TLRs and their ligands from microbial pathogens induce a cascade of intracellular signalling events that leads to the increased expression of pro-inflammatory cytokines. Although the TLR-mediated inflammation is beneficial for the host to defend against the microbial pathogens, it acts as a double-edged sword under some circumstances. The aberrant activation of TLRs is reported to cause various inflammatory disorders in animals and humans. TcpB protein of Brucella is cell permeable and it selectively inhibits NF-κB activation and secretion of pro-inflammatory cytokines mediated by TLR2 and TLR4 receptors. We generated cell permeable and anti-inflammatory peptides from the TcpB protein, followed by their characterization. Further, we synthesized a chimeric peptide (TB4-BBL2), which harbours both the cell permeability and anti-inflammatory properties. The chimeric peptide could efficiently suppress TLR4-mediated secretion of proinflammatory cytokines by the macrophages (Fig. 2). Further studies are in progress.

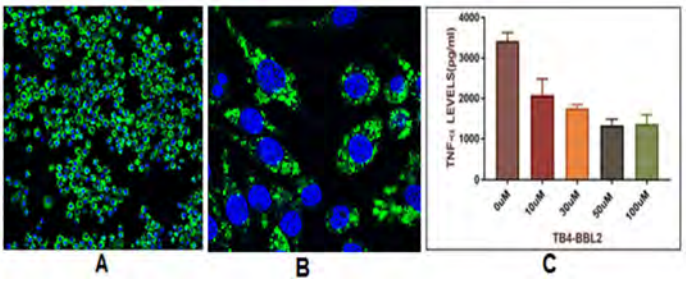


Fig 2. *(A & B) Internalization of TB4-BBL2 peptide by mouse macrophages. (C) A dose dependent suppression of LPS-induced TNF-a secretion by TB4-BBL2 peptide.*

To characterize the host factors that support the invasion and intracellular multiplication of Brucella.

Identification and characterization of virulence mechanisms of a pathogen are essential for developing efficient therapeutic and preventive strategies for infectious diseases. Compared to other bacterial pathogens, minimal information is available on factors contributing to persistence of Brucella in the host and its replication in the macrophages. Using a high-throughput siRNA screening, we identified many host proteins, which are essential for survival of Brucella in the macrophages. Subsequently, we performed detailed characterization of one of the host proteins, F-box (FBX) protein. The silencing and overexpression studies indicated that FBX protein is required for

the invasion of Brucella into macrophages. Further, we observed that the intracellular multiplication of Brucella induced the upregulation of FBX protein in macrophages that resulted enhanced secretion of TNF-α. Further studies are in progress.

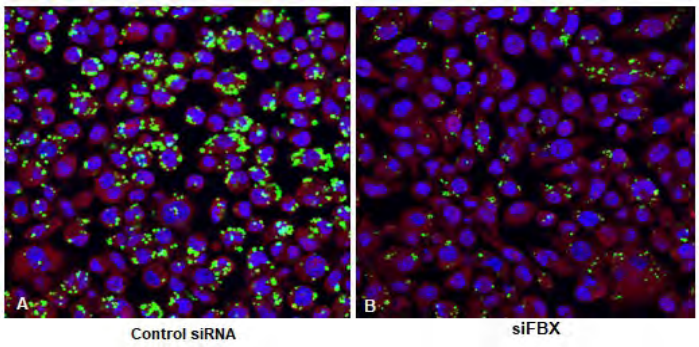


Figure 3. F-box protein contributes to the invasion of Brucella into macrophages. Panel (A) and (B) shows B. neotomae-GFP invasion assay using J774 macrophages transfected with control siRNA and siRNA targeting F-box protein, respectively. The invasion of B. neotomae-GFP was affected in the siFBX treated macrophages.

Patent

Applied: -

Immunodominant protein and peptide-based brucellosis diagnosis kits and devices to differentiate infected animals from Brucella abortus S19-vaccinated animals.

Indian patent application number: 201941010993

The Lab Photo

Left to right: Prachita Nandini, Swapna Namani, Padmaja Jakka, Sushreerekha Mallik, Girish Radhakrishnan, Binita Roy, Kiranmai Joshi, Swetha Sankati and Varadendra Mazumdar.

Title: Development of Leptospirosis vaccines and novel adjuvants

Syed M. Faisal

Principal Investigator: **Dr. Syed M. Faisal**

PhD Students:
Vivek P. Varma
Ajay Kumar
Mohd. Kadivela
Pallavi Vyas

Project Fellow/RA/Trainee
Sridhar Kavela
Ramudu Bankala

Collaborators:

Yung-Fu Chang	Cornell University, USA
Mathieu Picardeau	Pasteur Institute, France
Mirza Saquib Baig	IIT, Indore
Ramu Sridhar	University of Hyderabad
Mohd Akif	University of Hyderabad
Nirmalya Ganguly	NIAB, Hyderabad
Sarwar Azam	NIAB, Hyderabad

Our research is focussed broadly in two areas. First, development of vaccine for Leptospirosis which is zoonotic and emerging infectious disease in India. Using modern biological tools and various approaches we are trying to understand how *Leptospira* interacts with the host and how host respond to this infection. This will help in identifying crucial virulence factors that could be potential targets for development of vaccine and diagnostics for serovars prevalent in India. Second, development of novel adjuvants /delivery systems for veterinary vaccines. Current vaccine against dreadful diseases like brucellosis and FMD provide short term immunity and limited protection mainly due to unavailability of potent adjuvants. Hence we envisage to develop potent adjuvants for vaccines used in Livestock. Broadly our research is aimed at-

Identification and characterization of surface proteins of *Leptospira* involved in evasion/activation of host immune response: In perspective of developing subunit vaccines. *Leptospira* evades through host innate immune response by avoiding recognition through Toll like receptors (TLR2 and TLR4) and also through complement system by employing various mechanisms like binding to complement regulators (Factor H, C4BP), secreting proteases etc. to establish successful infection in the host. We cloned, expressed and purified few surface proteins of *Leptospira* viz. LenB, LenD, LenE, Lsa30 (Fig 1A). In an effort to characterize the domain of the most promising vaccine candidate *Leptospira* immunoglobulin like protein A (LigA) we expressed and purified various domains of variable region LigA (LigAvar) and tested its binding with various complement regulators like Factor H and C4BP and PLG. Factor H showed binding with 11th domain of domains of LigA (Fig 1B). This project will contribute in identification of novel virulence factor/ vaccine candidates.

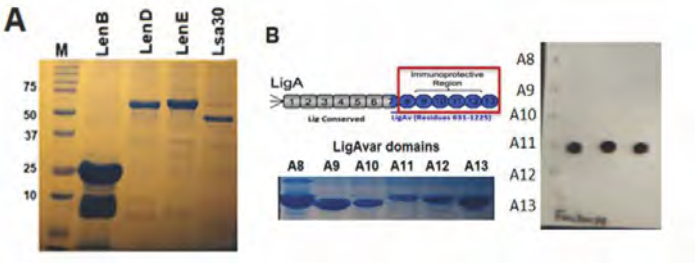


Fig 1. *(A) Purification of various surface proteins (virulence factors) of Leptospira. (B) Factor H binding with various domains of LigAvar as determined by dot blot.*

Understanding the role of *Leptospira* LPS in evasion from host innate immune response

Lipolysacchafide (LPS) is major antigen of *Leptospira* Previous reports have shown that *Leptospira* LPS is atypical and signals via TLR2 instead of TLR4. In order to understand the role of LPS in immune evasion we tested signalling mechanism of LPS isolated from non-pathogenic *L. biflexa* and different pathogenic serovars *(L. hardjo, L. pomona, L. icterhaemorrhagie)*. Our results showed that all LPS are recognized by TLR4 receptor (Fig 2). Further this signalling was mainly mediated by MyD88 except LPS isolated from serovar Pomona which signalled via TRIF pathway (Fig. 2). This project is aimed at immunocharacterization of *Leptospira* LPS and eventually development of LPS (Lipid A) based conjugate vaccines.

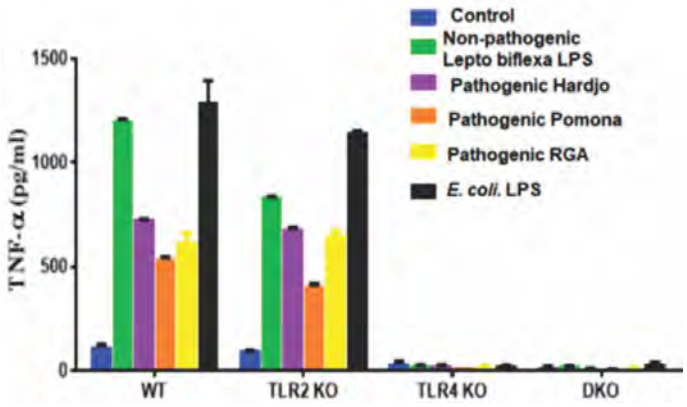


Fig 2. *TNF-a produced by WT, TLR2KO, TLR4KO and TLR32/4 DKO mouse macrophages after stimulation with LPS isolated from different serovars*

Creating *Leptospira* mutants: In perspective of identifying novel virulence factor and vaccine candidates

We are trying to create both random and targeted mutants of *Leptospira* to make them attenuated in virulence. Although we got several random mutants on kanamycin EMJH plates we are experiencing difficulties in screening these mutant colonies. We are trying to troubleshoot the problem. For targeted mutagenesis we have successfully created plasmid pSLe94-flgb-EGFP and showed that *Leptospira* transformed with this plasmid can expresses EGFP. We are in process of replacing EGFP with Cas9 gene and then introduce this plasmid along with guide RNA to create targeted mutants. This project will lead to development of live attenuated vaccine for Leptospirosis.

Genomics assisted pathobiology to identify novel targets for diagnosis and therapeutic intervention(s) of Leptospirosis

Preliminary testing of interaction of *Leptospira* with various hosts was done in vitro. Using mouse macrophages, we tried to understand the changes in gene expression in pathogen (in order to identify critical virulence factor) and also the changes in the host cells. Preliminary data shows that genes coding for critical virulence factors (surface proteins) are expressed by pathogenic *Leptospira* upon interaction with host cells (mouse macrophages). These transcripts were not detected in non-pathogenic *Leptospira* (Fig. 3A). On analysing the host response, genes coding for cytokines and chemokines involved in host innate defence were expressed at early stage (2hrs post infection). These transcripts were detected at low level and at later stages in macrophages infected with non-pathogenic *Leptospira* (Fig.3). Similar analysis will be performed in human and bovine macrophages this project will contribute in identification of criticle factors of both host and pathogen for development of drugs/vaccine .

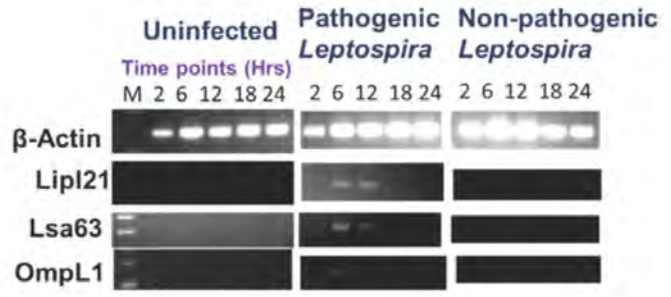


Fig 3. *Analysis of virulence genes of Leptospira expressed upon interaction with host. Several genes coding for virulence factors (surface proteins) like LipL21, Lsa63, OmpL1 were upregulated upon interaction of Leptospira with mouse macrophages. These genes were not expressed by non-pathogenic Leptospira.*

Development of novel immunomodulators/ adjuvants for veterinary vaccines.

In an effort to develop novel veterinary adjuvants we are standardizing assays for screening TLR agonists on Bovine macrophages and dendritic cells. We tested immunomodulatory activity of various TLR agonists like PAM3CSK4 (TLR2 agonist), LPS/MPLA(TLR4 agonist), Flagellin (TLR5 agonist), Immoquinod (TLR7 agonist) on bovine macrophage cell line (BoMac cells). Cells stimulated with these agonists induced

production of cytokines and upregulated number genes involved in activation and immunomodulation (Fig. 4A). In an effort to develop some new adjuvants against most promising vaccine candidate antigen of *Leptospira* (Leptospira Immunoglobulin like protein A) we tested LigA incorporated in AS04 (Alum with MPLA) and LigA in Montanide ISA720. Both the adjuvants induced superior antibody response than LigA in alum adjuvant (Fig. 4B).

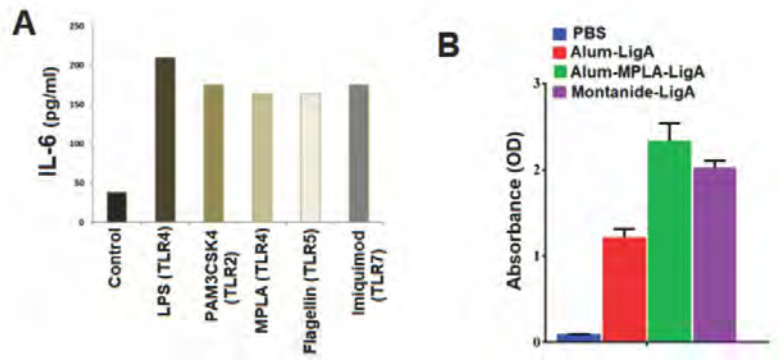


Fig 4. *(A) IL-6 produced by Bovine macrophages (BoMac cells) upon stimulation with various TLR agonists. (B) Antibody response in mice immunized with Leptospira immunoglobulin like protein A with various adjuvants.*

Publication

Baig MS, Anjali Roy, Rajpoot S, Dongfang Liu, **Faisal SM Saluja R, Saqib U, Ohishi T, Wary KK**. Tumour-derived exosomes in the regulation of macrophage polarization. Inflamm Res. **2020**, 69, (5) 435–451.

The Lab Photo

From left to right: Mohammed Kadivela, Vivek Varma, Syed Faisal, Ramudu Bankala, Pallavi Vyas, Ajay Kumar, Sridhar Kavela(Absent).

Title: Host Pathogen Interaction Studies on Animal and Avian Viruses

Madhuri Subbiah

Principal Investigator: **Dr. Madhuri Subbiah**

Phd.D. Students:
B. Nagaraj Nayak
Sunny Deval
Ruchi Malwade

Project Fellows:
Devasmita Dutta
Lakshmana Rao Pachineella

Collaborators:

Prof. Vengupal Nair, The Pirbright Institute, UK
Dr. Tridib Rajkhowa, Central Agricultural University, Mizoram
Dr. Gowtham Vasudevan, Veterinary College and Research Institute campus, TANUVAS
Prof. Elango, Gandhigram Rural Institute, Gandhigram
Dr. Rajkumari Sanjukta (Scientist, ICAR-NEH, Meghalaya)

The major challenge in poultry industry is frequent disease outbreaks. Newcastle disease virus (NDV), an economically important poultry virus causes highly contagious respiratory, neurological and/or enteric disease in chickens. Our lab is studying molecular biology of non-structural proteins of NDV (V and W) to determine their role in pathogenesis and immune evasion for developing effective live vaccines through reverse genetics system.

Previously, we showed that W protein of NDV strain Komarov localized in nucleus in different cell lines (DF1, BHK21, Vero) at 12, 24 and 48 h post transfection. We were able to identify the nuclear localization signal by mutagenesis. However, when we analyzed the W protein of other strains of NDV (around 900 strains) using bioinformatics, we could infer that only about 50% of the studied strains were predicted to localize their W proteins in the nucleus.

To understand the mechanism by which W protein is localized in the nucleus, we used Ivermectin, a specific inhibitor of importin αβ-mediated nuclear import.

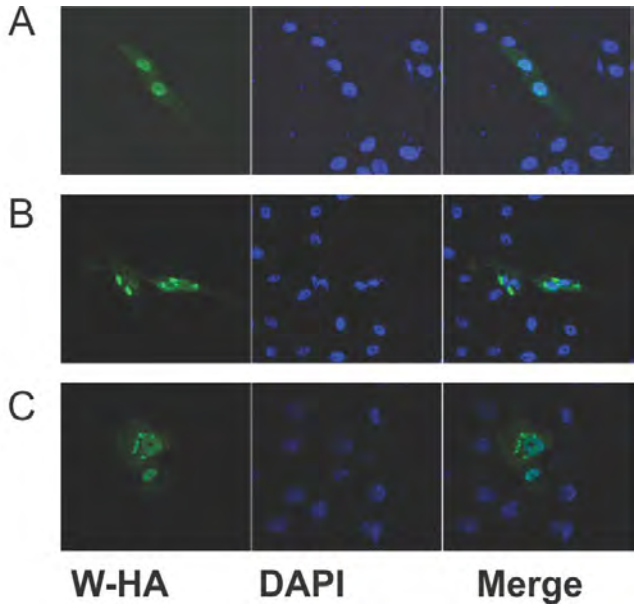


Fig 1a. *Effect of Ivermectin on nuclear localization of W protein.*

A) W expression visualized by staining W-HA plasmid-transfected Vero cells with anti-HA FITC B) W-HA transfected Vero cells treated with 25 μM Ivermectin for 1 hour and C) W-HA transfected Vero cells treated with 50 μM Ivermectin for 1 hour. The W protein in untreated cells (A) localized in the nucleus, while in the Ivermectin treatments (B and C) the W protein was largely in cytoplasm.

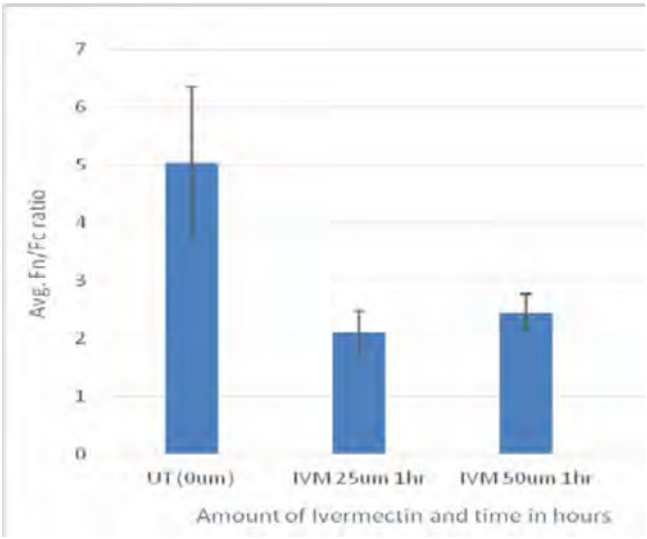


Fig 1b. *Effect of Ivermectin on nuclear localization of W protein and the nuclear to cytoplasmic ratio*

The nuclear to cytoplasmic ratio of W protein localization was reduced in Ivermectin treated cells, clearly showing that the W protein is imported into nucleus through importin αβ pathway.

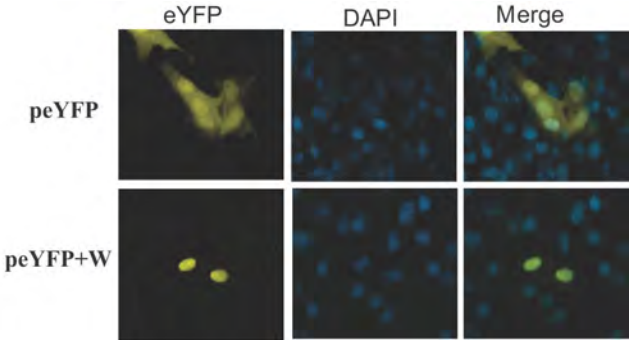


Fig 2. *Immunofluorescence images of W+eYFP and eYFP expressed by transfection of pW+eYFP and peYFP plasmids in Vero cells*

To further understand the role of W protein during NDV infection, we have constructed W+eYFP plasmid that will be useful to express W protein as a fusion with eYFP.

The W fusion protein was localized in the nucleus while the eYFP was observed in both cytoplasm and nucleus.

The second area of interest in our lab is on Porcine circoviruses (PCV). Porcine circovirus (PCV) is a small, non-enveloped, single-stranded DNA virus with a circular genome. PCV1 is non-pathogenic virus, often a contaminant in PK15 cells while PCV2 is a significant pathogen of pregnant sows causing abortion, stillbirth, birth of small and weak sized piglets leading to high mortality in pre weaned piglets. In post weaned piglets it causes wasting with clinical signs of pneumonia, diarrhea and anemia and in finisher pigs it causes dermatitis and glomerulonephritis. Porcine Circovirus type 2 associated diseases (PCVAD) is an emerging and important transboundary disease in pig population of India. PCVAD also results immunosuppression in affected pigs. We are attempting engineering chimeric virus with PCV1 backbone which could be used as a potential live vaccine.

We have generated single cell clones (SCC) of PK15 devoid of PCV1.

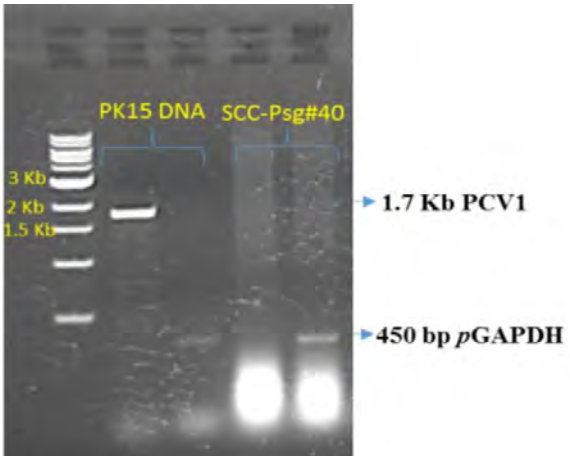


Fig 3. *Test PCR on PK15 cells and SCC for porcine specific GAPDH and PCV1*

We have screened one SCC that has tested PCV1 negative until passage 40 by both PCR and QPCR.

To optimize the engineering of recombinant PCV, the following strategy was undertaken: Three TOPO clones carrying fragments of PCV-2 field strain was supplied by Dr. Tridib Rajkhowa from his clinical isolation. They were serially cloned in our lab to obtain full length genome of PCV2 in between Nhe1 and Not1 sites within TOPO vector and this clone was used in subsequent transfection experiments in SCC. The transfected cells were treated with 300 mM concentration of D-Glucosamine for 1 hr at 24 hrs post transfection. Following three passages, genomic DNA was isolated from these cells and tested by PCR using primers specific for GAPDH, PCV1, PCV2 and TOPO vector and by immunostaining using PCV2 specific antibody (VMRD).

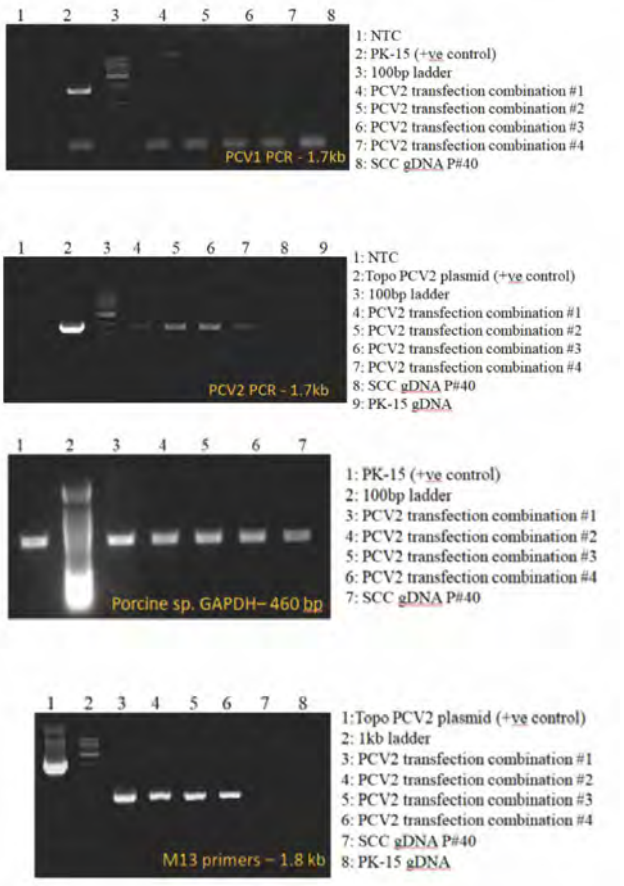


Fig 4. *Test PCR on TOPO-PCV2 transfected cells and SCC for porcine specific GAPDH, PCV1, PCV2 and TOPO vector (M13 primers).*

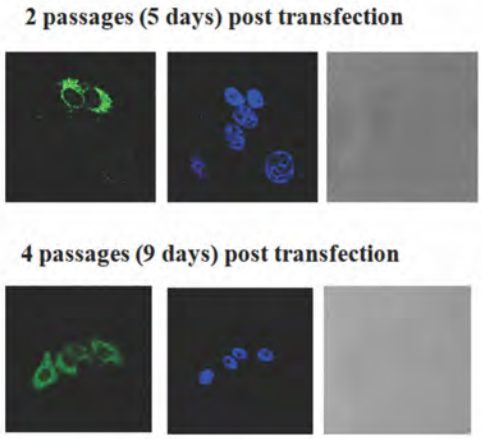


Fig 5. *Immunostaining of TOPO-PCV2 transfected cells using VMRD antibody against PCV2.*

Publications:

- Vennila KN, Prabha K, Deval S, **Subbiah M**, Elango KP. Preparation and biological evaluation of quinoline amines as anti-cancer agents and its molecular docking. Medicinal Chemistry Research 28, 1298–1307 (2019).
- G. Mahalakshmi, K. N. Vennila, B. Selvakumar, P. Lakshmana Rao, Ruchi Malwade, Sunny Deval, **S. Madhuri**, M. Seenivasaperumal & Kuppanagounder P. Elango. Spectroscopic investigations on DNA binding profile of two new naphthyridinecarboxamides and their application as turn-onfluorescent DNA staining probes. Journal of Biomolecular Structure and Dynamics 28, 1-9 (2019).

The Lab Photo

Left to right: Sunny Deval, Nagaraj Nayak, Lakshmana P. Rao, Madhuri Subbiah, Ruchi Malwade, Devasmita Dutta

Title: Host-Parasite Interactions Studies on Animal Parasites

Anand Srivastava

Principal Investigator: **Dr. Anand Srivastava**

PhD students:
Prasanna Babu Araveti
Prajna Parimita Kar
M. Rajitha

Post-doctoral fellows:
Dr. Soma Behera, Research Associate (Till Mar 2020)
Dr. Shalu Varunan (Till Apr, 2019)

Project Fellows/Trainees:
Vijay Macha
Akshay Kuriakose (Since July 2019)
Nagaraju Goud, Lab Technician (Till Nov 2019)

Collaborators:

Dr. B. Kala Kumar	PVN Rao Veterinary University
Dr. Swasti Raychaudhuri	CCMB, Hydrabad
Dr. Gajanan Chigure	MAFSU, Parbhani

Theme of Research

My research group works on Ticks and Tick-borne diseases (TTBDs). The Ticks and Tick-borne diseases (TTBDs) have been recognized as a major cause of production loss in ruminants. TTBDs are quite prevalent in tropical and subtropical countries of the world. The estimated cost of production loss due to TTBDs in India is approximately US$ 498.7 million/ annum. In case of tick-borne diseases my research group focuses on Theileriosis. This disease causes unchecked proliferation of the leucocytes. The untreated cattle die in 3-4 weeks. The present vaccine and drug molecules have their own limitations. Hence, we are in the quest of developing better interventions in form of vaccine and drug molecules for curing theileriosis. Currently, we are in the process of identifying newer targets for vaccine development and working on identification of new drug molecules.

Objectives

1. **To identify novel drug molecule for treating Theileriosis (Intramural)**

   We would like to develop a cost-effective drug which could reduce the drug regime for treatment of theileriosis from a week to few days. We would like to repurpose the known drugs for treatment of the Theileriosis.

2. **To identify new molecules that are essential for the survival of *T. annulata* (Extramural)**

   We would like to identify *T. annulata* proteins which are important for the transformation of the host cell and are essential for the survival of the parasite in the host cell. These proteins could be targeted for developing drug or small molecule as inhibitor.

Work Reported in 2018-2019

- **Curcumin induced oxidative stress causes autophagy and apoptosis in bovine leucocytes transformed by *Theileria annulata***

  We demonstrated that curcumin inhibits the proliferation of *Theileria*-transformed bovine leucocytes by promoting apoptosis and autophagy. The transcriptome analysis of curcumin treated cells revealed that curcumin specifically regulates genes that are involved in the apoptosis and autophagy pathway. We further elucidated the mechanism of action of curcumin on *Theileria* infected bovine cells. We found that curcumin induced the generation of reactive oxygen species (ROS) which activated caspase 8 and destabilized the mitochondrial membrane potential leading to the release of cytochrome c from mitochondria. This subsequently led to the activation of caspase 3 and PARP cleavage, finally leading to apoptosis in the infected cells. Furthermore, curcumin induced the process of autophagy which was characterized by the formation of acidic vesicular organelles, LC3B accumulation with lysosome inhibitor, E64d, and the presence of autophagosomes as visualized by transmission electron microscopy (TEM). Curcumin treatment suppressed the mTOR and increased the expression of autophagy-related proteins. We also found that N-acetylcysteine, an inhibitor of ROS, could rescue the infected cells from curcumin induced apoptosis and autophagy mediated cell death. Intriguingly, curcumin had no effect on uninfected bovine PBMCs. Altogether, these data suggest the therapeutic potential of curcumin against bovine tropical theileriosis. This work got published recently **(Araveti PB, and Srivastava A. Cell death discovery 2019).**

- **Identification of novel vaccine candidate(s):** In continuation of our work published in **Frontiers of Immunology 2018; 9: 2213**, where we identified 21 proteins which were predicted to generate effective humoral response against T. annulata, we designed primers for 8 genes containing B cell epitope namely TA12115, TA16125, TA17055, TA13820, TA11900, TA21140, TA13810 and, TA09755. Total RNA of *T. annulata* infected lymphocyte cells was extracted using NucleoSpin (MN) RNA Plus following the standard protocol and the cDNA was obtained through reverse transcription by using a cDNA synthesis kit. Cloning, expression and purification of these proteins were initiated.

- **Elucidation of the mechanism(s) of transformation of host cells by *Theileria annulata:*** Yeast two hybrid cDNA library of *Theileria annulata* infected Bovine lymphocytes was constructed. Further, bait plasmid (pGBKT7-TA04375 [Prohibitin] and pGBKT7-TA13185 [peptidyl-prolyl cis-trans isomerase] containing Ta-Prohibitin and Tacyp was prepared and its expression was analysed using anti-myc antibodies. Auto-activation and toxicity detection of TA04375 and TA13185 (bait) in yeast cells were also analysed. The cDNA library and bait were used for yeast two-hybrid screening. After screening the library it was found that TA04375 interacts with bovine RUVBL1 while TA13185 interacts with bovine BUD23.

Progress of work during the current reporting year (2019-2020)

- **Discovery of anti-theilerial compounds against *Theileria annulata* in the Pathogen box** Theileriosis is a lymphoproliferative, cancer-like disease in cattle that causes significant economic loss to farmers in the Mediterranean, Middle East, northern African, Asian, and the Far East regions. It is caused by intracellular schizonts of the apicomplexan parasite *Theileria annulata.* It causes severe infection to cattle and the untreated cattle die within 3-4 weeks of infection. The chemotherapy for this disease is largely dependent on the use of hydroxynaphthoquinone, namely buparvaquone. Recently, there have been reports of the development of resistance against this drug in *T. annulata.* Hence, identification of new drug molecule(s) or repurposing of drug molecule(s) against *T. annulata* is quite important. Here, we carried out the screening of 400 compounds included in the open-access Pathogen box from Medicine for Malaria Venture (MMV) to discover the novel compounds with potential inhibitory activity against *T. annulata* infected bovine leucocytes. The schematic representation

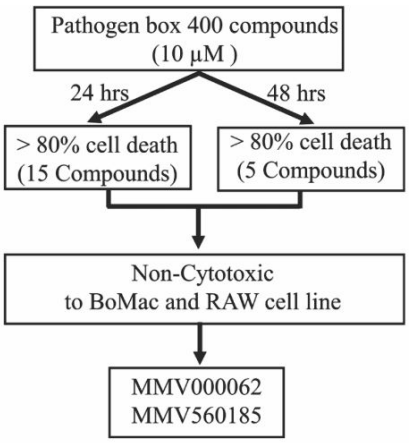


Fig 1: *Schematic representation of workflow for screening and identification of anti-theilerial from Pathogen box.*

of workflow is presented in figure 1.

A screen of Pathogen box identified compounds with anti-theilerial activity

We identified two compounds, MMV000062 and MMV560185, with *IC50* values 2.97 µM and 3.07 µM, respectively. MMV000062 and MMV560185 were found to be non-toxic to BoMac and RAW 264.7 cell lines with CC_{50} values of >100 µM and 34 µM, respectively. The therapeutic index of these compounds, MMV000062 and MMV560185, was calculated as >33 and 11, respectively.

Cell death by MMV560185, and MMV000062 is not due to apoptosis or DNA damage

The two compounds, MMV000062 and MMV560185 which were non-cytotoxic to the tested cell lines, BoMac and RAW 264.7, were further analyzed for their mode of action leading to the cell death of the cell. We performed TUNEL assay, and annexin V/propidium iodide staining to find out whether cells were undergoing apoptosis. For both TUNEL assay and annexin V/propidium iodide staining, we treated infected cells with two compounds at their IC_{50} concentration, and assays were performed after 48 hours. We found that neither of the compounds induced apoptosis in the Ana2014 cells (Figure 1a). Also, we did not observe any DNA fragmentation after 48 hours in infected cells with either of these compounds at IC_{50} concentration (Figure 1b).

MMV560185, and MMV000062 specifically act on the Theileria parasite

In order to find out whether these compounds were active against parasite or host cells, we cultured Ana2014 cells with each compound for 48 hours. After 48 hours, RNA and cDNA were prepared. Quantitative real time PCR (qRT-PCR) was performed using this cDNA. The analysis of qRT-PCR showed that there was a decrease in the

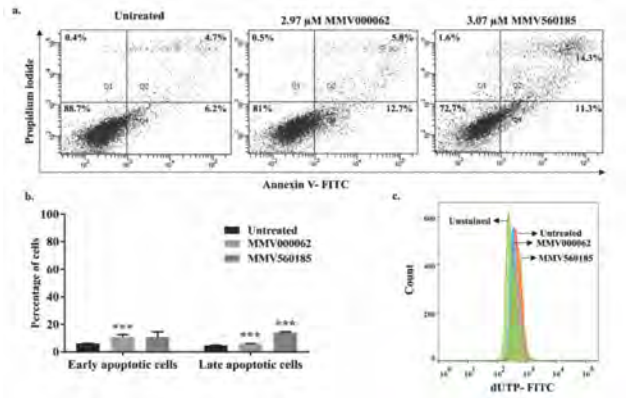


Fig 2: *Dot plot showing Annexin V FITC- PI staining of untreated, MMV0000062, and MMV 560185 treated Ana2014 cells for 48 hours, b. showing the percentage of early apoptotic, and late apoptotic cell population in three independent experiments. c. Analysis of DNA fragmentation by compounds MMV000062 and MMV560185. (i) unstained, (ii) untreated, (iii) 2.97 µM MMV000062, and (iv) 3.07 µM MMV560185, N=3. Data are presented as mean ± SD. *** represents p<0.001, compared with the untreated group.*

RNA level of *Theileria* specific proteins (TaSP) with respect to the bovine endogenous control (Figure 3a) suggesting that these compounds would be killing the parasite and due to which the mRNA of highly abundant parasite protein would tend to decrease.

Long term culture with MMV560185, and MMV000062 do not led to resistance in the parasite

In order to understand the effect of these two compounds on long term culture, Ana2014 cells (2x106 cells) were incubated with complete RPMI 1640 media with each drug at IC_{50} for 12 days at 37°C with 5% CO_2 in a humidified incubator. Ana2014 cells were unable to recover when treated with MMV560185 and MMV000062. All the cells were found dead on the 6th day and the 10th day of incubation with compounds MMV560185, and MMV000062 respectively (Figure 3b). However, Ana2014 cells were able to recover in buparvaquone treated cells. There was an increase in the number of viable cells in Ana2014 cells after 10th day of incubation with the compounds. This suggests that a long term treatment with buparvaquone leads to the development of resistance in the Ana2014 cells.

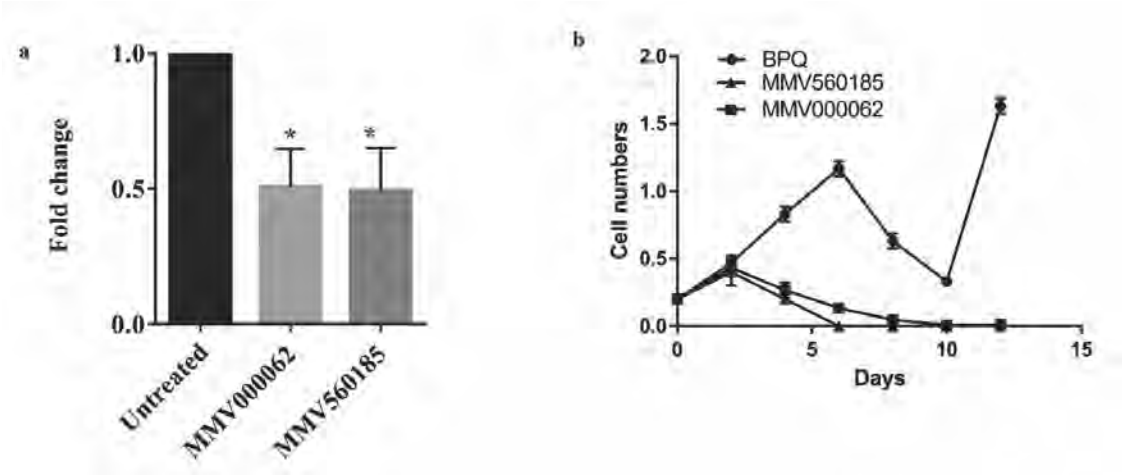


Fig 3: a. *Real time PCR (qRT-PCR) analysis of TaSP vs Bovine TBP (TATA box binding protein) and Bovine PPIA (Peptidylprolyl isomerase A) upon treatment with MMV000062 and MMV560185. The fold change of the TaSP genes was normalized with endogenous controls BoTBP and BoPPIA. The experiments were performed thrice (biological replicates) and each in triplicates (technical replicates). Data are presented as mean ± SD. The statistical tests were performed with the software Graphpad Prism (Version 7.04). The data were statistically analyzed by multiple t-test. * represents $p < 0.05$, compared with the untreated group. b. Comparison of long term culture (14 days) of Ana2014 cells with the compounds MMV000062 and MMV560185 with buparvaquone (MMV689480).*

- **Elucidation of mechanism(s) of transformation of host cells by Theileria annulata:**

  Previously, we prepared a yeast two hybrid cDNA library containing cDNA of host (cattle) and parasite *(T. annulata)*. The cDNA library and bait (TA04375 and TA04375) were used for yeast two-hybrid screening. After screening the library it was found that TA04375 (Ta-Prohibitin) interacts with bovine RUVBL1 and TA13185 interacts with bovine BUD23. In 2019-20 we further characterized the interaction of TA04375 interacts with bovine RUVBL1.

  Expression and purification of Ta prohibitin and generation of antibodies against Ta prohibitin

  Ta prohibitin was cloned in pET21a vector and expressed as a recombinant protein. The recombinant protein was expressed as the inclusion bodies. We tried various methods to get this protein in soluble fraction. However, our all efforts were unsuccessful. Hence, we purified the inclusion bodies through Ni-NTA chromatography and used this protein for raising antibodies in mice. The titre of mice antibody was tested and was found to be 1:50000.

Validation of interaction using pull down assay

In order to further prove that these proteins (Prohibitin and RUVBLl) do interact with each other, we cloned these genes in pDUET vector. This vector can express both proteins simultaneously. After confirming that both these proteins are expressed in bacterial expression system we performed the pull down assay. Using anti-His antibodies we pulled down recombinant Ta Prohibitin protein and probed with anti-RUVBLl antibodies. We found that Ta Prohibitin could pull down RUVBLl suggesting that these two proteins interact with each other (Figure 4a,b).

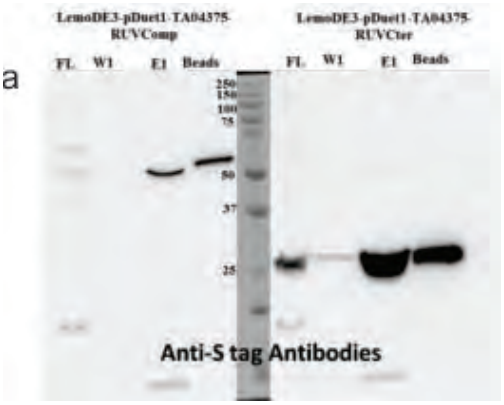


Fig 4. *Pull down experiment: a. Probing RUVBL1-S tag with S-tag antibodies. Pull down of prohibitin with anti-his antibodies showed interaction with RUVBL1 protein. Identification of other interacting molecules*

Since RUVBL1 protein contains S-tag we probed this protein after pulling down Prohibitin with anti-his antibodies. We found that Ta Prohibitin could pull down RUVBLl which confirms that these two proteins interact with each other (Figure 4)

In order to find whether Prohibitin-RUVBL1 forms a complex with other proteins, we cloned Ta prohibitin and RUVBLl in pcDNA3.1 myc BirA vector. The plasmids were transfected in HEK-293T cells. Both the proteins were found to express in HEK-293T cells (Figure 5). Since BirA protein would catalyze site-specific biotinylation of proteins if interacting, we will perform pull down assay and the proteins interacting proteins will be identified using LC-MS/MS.

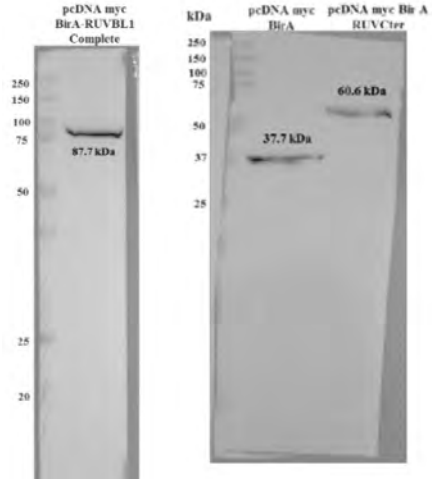


Fig 5: *Expression of myc BirA (37.7 kDa), myc BirA-Ruvbl1 c-term (60.6kDa), and myc BirA-RUVBL1FL (87.7 kDa).*

Future Plans

- **Identification of novel vaccine candidate(s):**

  The previously identified antigenic proteins (Kar et al; 2019) will be cloned, expressed and purified. The antibodies will be raised against all the purified proteins. The antibodies would be used for their recognition to the parasite or to the host cell surface. Antibodies will be further used for antibodies dependent cytotoxic assay.

- **Elucidation of mechanism(s) of transformation of host cells by *Theileria annulata*:**

  Work will be undertaken to find out whether Ta-Prohibitin and RUVBL1 form a complex with other proteins. And if so, work will be undertaken to find out what are the different proteins involved in this complex. For this purpose, pulldown assay, confocal studies, knock down of bovine RUVBL1 will be performed.

Publication

1. Araveti PB, **Srivastava A***. Curcumin induced oxidative stress causes autophagy and apoptosis in bovine leucocytes transformed by Theileria annulata. Cell death discovery (2019) 5:100.

The Lab Photo

Left to Right: Prajna Parimita Kar, Soma Behera, Shalu Varunan, Vijay Macha, Anand Srivastava, Prasanna Babu Araveti, M. Rajitha

Title: Study of Virulence, Antimicrobial Resistance and Host Pathogenesis in Intracellular Pathogen Infections

Paresh Sharma

Principal Investigator: **Dr. Paresh Sharma**

PhD Students:
Mr. Sonti Roy
Mr. Debabrata Dandasena
Mr Akash Suresh
Ms. Sonam Kamble

Project Students:
Ms. Umarani Brahma,
Ms. Madhumanti Barman

Women Scientist:
Ms Shweta Noori

Collaborators :

Dr Vasundhra Bhandari	NIAB, Hyderabad
Dr Avery August	Cornell University, USA
Dr. Bappaditya Dey	NIAB, Hyderabad
Dr. Partha Ray	UOR, UK
Dr Anand Kumar	NTR College, AP.
Dr Azhahianambi P	TANUVAS, Chennai.

Our group is interested in understanding the mechanism of disease pathogenesis behind major intracellular parasites using advance biotechnology tools. The major intracellular pathogens which we are studying are livestock related haemoprotozoan parasites and mastitis causing bacterial pathogens. The focus is to identify and characterize the genes involved in Host Parasite Interactions/Virulence/ Drug resistance that could lead to development of tools/strategies for controlling the disease. We are also working on the global problem of antibiotic resistance, which equally effects animal and humans and is a global threat of increasing concern. We are focusing on surveillance of AMR pathogens, understanding antibiotic resistance mechanism, identifying new drug targets and repurposing of the available drugs.

1: Identification of Genetic and Antigenic variations in Haemoprotozoan parasites causing Livestock Infections:

Understanding the genetic diversity of the *T.annulata* population can be a useful to characterize parasite populations. The extent of parasite genetic diversity and the parasite population structure, will provide insight about parasite transmission trend and parasite population history, an information that is vital for assessing the impact of *Theileria* elimination interventions. Microsatellites markers have been employed extensively to study *Theileria* parasite population structure in other countries like China, Oman, Sudan, Tunisia and Turkey, however, the information is missing from India. In the current year, we have collected samples from the animals suspected for theileriosis from four different geographical locations of India, Telangana (N=35), Gujarat (N=30), Haryana (N=30) and Bihar (N=30). In total 125 animals were selected from the 4 states for studying genetic diversity and population structure of the Indian parasites using genotyping based on the 10 microsatellite markers. The genotyping profiling of 125 samples showed high polymorphism in all the 10 markers, with overall number of alleles ranging from 26 to 8 per marker (Fig: 1). The allelic data from the 4 states identified 125 unique haplotypes. The genotyping showed presence of mixed parasite infections in each isolate based on the presence of multiple alleles at each locus. The allelic data per locus was next used for calculating MOI for each sample

from all the states. The MOI values for Gujarat, Haryana and Telangana were found to be significantly higher when compared to Bihar (Fig: 2). Since, multiple alleles were found in the samples, a MLG profile was created by selecting the predominant allele from the each locus for all the 125 samples. The MLG data was further used for calculating the expected heterozygosity in between the states and in the total population. The expected Heterozygosity (He) was found to be high in samples across India. We also compared expected He of parasite population from India to previously reported T annulata isolates from countries like Sudan, Tunisia, China, Oman and Turkey. The genetic diversity was found to be highest in India (Fig :3). For understanding the genetic variance among the Indian *T.annulata* parasite population, pairwise Fst (fixation index) values were calculated using the MLG profiles. Based on the Fst data, genetic variance was found higher in Bihar parasite population when paired to Gujarat, Haryana and Telangana. Principal component analysis further confirmed that no geographical sub structuring was present between the parasite populations of different states suggesting presence of mixed population. The MLG data was next used for identifying Linkage disequilibrium (LD) in the Indian parasite population by calculating standard index of association (ISA). We found significant LD in parasite population of Telangana, Gujarat, Bihar and in total Indian population. Simultaneously, we are in process of raising antibodies against the *T. annulata* recombinant proteins which will be used for making diagnostic kit for antigen detection in the field. Further, we have also identified few molecules/drugs which are showing promising antitheilericidal activity against the *T. annulata* parasites, functional characterization is underway for understanding the mechanism of their action.

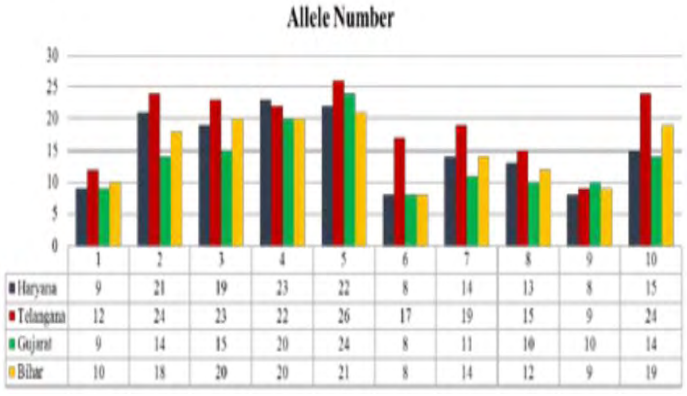


Fig 1. *Figure shows total number of alleles for all the ten microsatellite markers from the different states of India.*

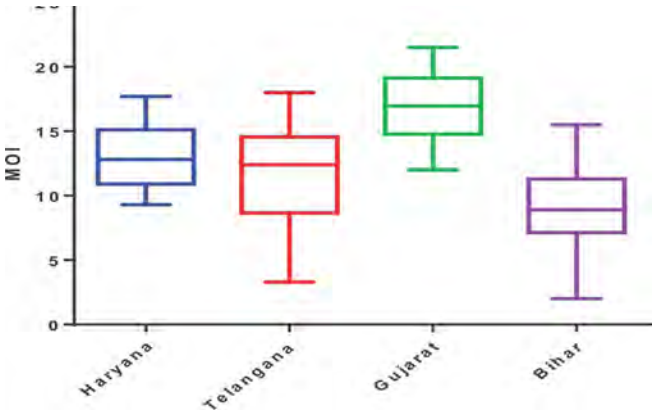


Fig 2. *Figure shows MOI values for Gujarat, Haryana, Telangana and Bihar.*

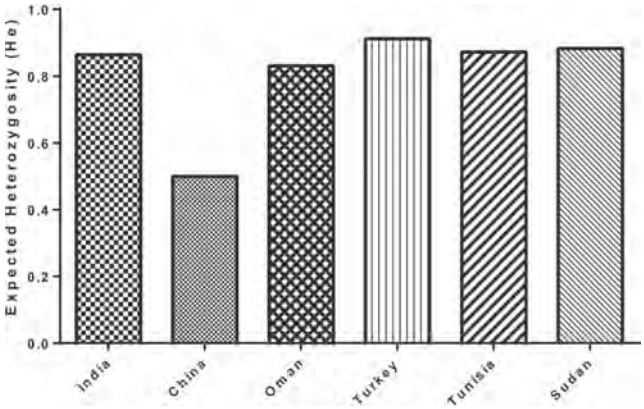


Fig 3: *Figure shows expected Heterozygosity (He) from different countries.*

2. Study of Host Parasite interactions to identify genes/ proteins involved in disease pathogenesis during *T. annulata* infection

Theileria annulata, an intracellular parasite of bovine lymphoid cells, induces substantial phenotypic alterations to its host cell including continuous proliferation, cytoskeletal changes and resistance to apoptosis. There remains considerable speculation on the complexities of the parasite directed control mechanisms that govern these radical changes to the host cell. The current projects in our lab are focused on identifying the genes associated with host parasite interactions and virulence during bovine theileriosis. We have done a comparative RNAseq analysis of an uninfected bovine cell line and its *Theileria* infected counterpart, to identify the differentially expressed genes during the parasite infection. The processed illumina reads were mapped to the reference *T. annulata* and Bos taurus genome available in the

Ensemble Genome database. Fragments Per Kilobase of transcript per Million mapped reads (FPKMs) for the data here were calculated using the 'fpkm' function of DESeq2 in R software. FPKMs for all genes in each of our parasite preparations were correlated using a Spearman's Rank correlation with FPKMs for each of the samples. Differential expression analysis was conducted using DESeq2 in R software. The differential analysis is under way for identifying the genes involved in disease pathogenesis.

3. Surveillance of antibiotic susceptibility, antimicrobial resistance mechanism and identification of new treatment options against bacterial pathogens causing mastitis:

Our project is aimed at phenotypic and molecular characterization of clinical isolates of *S. aureus* causing bovine mastitis using genomic tools. The findings from the project will help in determining the prevalent lineages. In addition, antibiotic resistance profiling of the clinical isolates will help us to obtain baseline data on the prevailing resistant and sensitive isolates and to identify any emerging resistant strain. With limited treatment options against resistant bacteria, we are also looking at identifying new potential antimicrobial agents as well as repurposing of drugs.

A) Out of 80 clinical isolates of *S. aureus*, we have determined 20 isolates as methicillin-resistant and 60 isolates as sensitive by cefoxitin and oxacillin susceptibility. Further, determinant of methicillin resistance, the mecA gene was checked in all isolates. Out of the 20 MRSA isolates, the mecA gene was amplified in 16 isolates while the rest of the 4 isolates did not show any amplification. In the mecA negative isolates, femA gene expression was analysed which was found to be down regulated (Fig 4). Overall antimicrobial profiling revealed the majority of the MRSA isolates (n=19) as MDR. While in the MSSA category, 27 out of 60 were MDR, 30 were resistant, and 3 isolates showed the sensitive phenotype. We have also found the prevalence of OS-MRSA strains indicating the importance of including both the genetic and phenotypic tests in characterizing S. aureus strains. Biofilm forming capacity was assessed which revealed isolates producing variable intensity biofilms, therefore, studies are underway to understand the mechanism behind strong and weak biofilm formation.

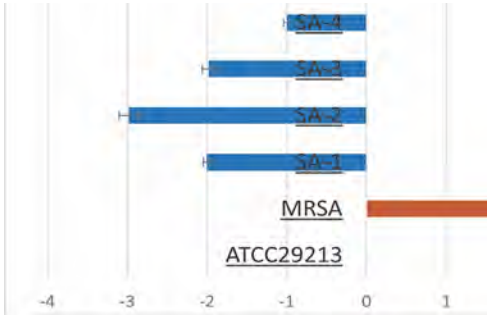


Fig 4: Expression profiling of the femA gene. *Real time PCR was used to determine the expression of the femA gene in the mecA negative MRSA (n=4) isolates using –2ΔΔCT method. ATCC 29213 and MRSA was used as control in the experiment and gyrB as reference gene.*

B) The milk samples from mastitis infected cows were screened for the presence of various AMR pathogens. We have collected 500 milk samples from infected cows belonging to different states of India. We have found the presence of both gram negative and gram-positive bacteria in the milk samples. Gram negative bacteria such as E. coli, Klebseilla sp, and Gram positive such as E. faecalis, Coagulase negative staphylococci, Bacillus sp were identified.

Publications from NIAB:

1. Roy S, Bhandari V, Dandasena D, Murthy S, **Sharma P.** Genetic Profiling Reveals High Allelic Diversity, Heterozygosity and Antigenic Diversity in the Clinical Isolates of the Theileria annulata From India.Front Physiol. 2019 Jun 7; 10:673.
2. Vandna B, Anita G, **Paresh S.** Haematological alterations and molecular detection of theileriosis in crossbred cattle. Indian Journal of Animal Sciences 89(6): 615–618, June 2019.
3. Umarani Brahma, **Paresh Sharma**, Shweta Murthy, Savitri Sharma, Shalini Chakraborty, Sundarapu Naga Appalaraju, Vasundhra Bhandari. Decreased expression of femXAB genes and fnbp mediated biofilm pathways in OS-MRSA clinical isolates. Sci Rep. 2019; 9 (1), 16028.

The Lab Photo

Left to Right : Akash Suresh, Madhumanti Barman, Vasundhra Bhandari , Shweta Murthy, Sonam Kamble, Uma Rani Brahma, K.Mohini, Sonti Roy, Paresh Sharma

Title: Role of CDK-related kinases (Crks) in transcription regulation in Toxoplasma gondii

Abhijit S. Deshmukh

Principal Investigator: Dr. Abhijit S. Deshmukh

PhD Students:
Poonam Kashyap
Kalyani Aswale
Chitti Raju Khandavalli

Project Personnel:
Rajkumar Gurupwar, PF (since Nov. 2017)
Nikita Pimpalkar, PF (since Jun. 2019)
Bhavana Hebbar, PF (since Dec. 2019)

Trainee:
Yamini Sri, MSc trainee (since Jan. 2020)

Collaborators :

Dr. Pallabi Mitra	UoH, Hyderabad
Dr. Sandeep Chaudhari	NVC, Nagpur
Dr. Shilpshri Shinde	NVC, Nagpur

Theme and Objectives of Research

We study the protozoan parasite *Toxoplasma gondii*, responsible for abortion, stillbirth and neonatal mortality in animal and human alike. Current research focuses on two important areas i) understanding the unique cell cycle and transcription using wide array of approaches, including protein biochemistry, cell biology and genetics ii) identifying immunodominant antigens to develop a rapid and cost-effective diagnostic assay for routine testing of *T. gondii* infection. The ongoing research is directed towards identifying potential drug targets and creating a robust diagnostic tool for mass screening of samples in the field.

Understanding the role of TgCrk2 in cell cycle of *Toxoplasma gondii*

Data mining of Toxoplasma genome has revealed limited repertoires of CDK-related kinases (Crks) and cyclins. Only ten Crks (20 in human) and seven atypical cyclins (29 in human) are encoded by this parasite. Given the absence of full repertoire of canonical CDKs and cyclins in Toxoplasma, the role and relevance of these proteins merit investigation. Earlier, we identified and characterized two cyclin-Crk pairs (CycH-Crk7 and CycL-Crk9) in *T. gondii*. We demonstrated that TgCrk7 kinase is important for transcription initiation whereas the kinase activity of TgCrk9 is essential for transcription elongation. Currently, we are working on one of the important cell cycle Crks, TgCrk2. Interestingly, only cyclins related to P-, H-, L- and Y-types were found, while no canonical A-, B-, D-, and E-types, that are vital to higher eukaryotic cell division, were identified in *T. gondii*.

To examine the role of TgCrk2 in cell cycle, we first identify its cyclin partner/s. The interaction of TgCrk2 with TgCycH or TgPHO80 or TgCycL (all three are essential cyclins) was tested using Co-IP experiments. TgCyH and TgPHO80 successfully co-immunoprecipitated with TgCrk2 confirming the interaction (Fig. 1A). However, no interaction was observed between TgCrk2 and TgCycL in the same Co-IP experiment. Further, IFA was performed to determine the localization of TgCrk2, TgCycH, TgPHO80 and TgCycL using specific antibodies. TgCrk2 was expressed in both nucleus and cytoplasm of the parasite (Fig. 1B). Both TgCycH and TgCycL were expressed in the nucleus (Fig. 1C,E) whereas TgPHO80 was localized exclusively in the cytoplasm (Fig. 1D). The

localization patterns suggest that TgCrk2 might be interacting with TgCycH in parasite nucleus whereas with TgPHO80 in parasite cytoplasm. However, it was still to be tested whether these Cyclin-Crk combinations resulted in an active kinase. In order to test that, in vitro kinase assays were performed using recombinant TgCrk2 either in the presence of TgCycH or TgPHO80 or TgCycL or HsRingo (non-cyclin CDK activator; positive control). The activated TgCrk2 was tested for its ability to phosphorylate histone H1 (universal substrate). TgCrk2 displayed histone H1 kinase activity only in the presence of TgCycH and not with TgPHO80 and TgCycL (Fig. 1F). Small molecule inhibitors Purvalanol and Staurosporine have been previously reported to effectively abrogate the mammalian Cdk1/2 kinase activity. In order to examine whether Purvalanol and Staurosporine could also inhibit the TgCrk2 kinase activity, we tested TgCrk2 kinase activity in presence of different concentrations of these inhibitors. A concentration dependent decrease of histone H1 phosphorylation was observed upon Purvalanol and Staurosporine (Fig. 1G,H) treatment suggesting the specificity of these inhibitors to TgCrk2. Further work with respect to understanding the role of TgCrk2 in cell cycle is underway.

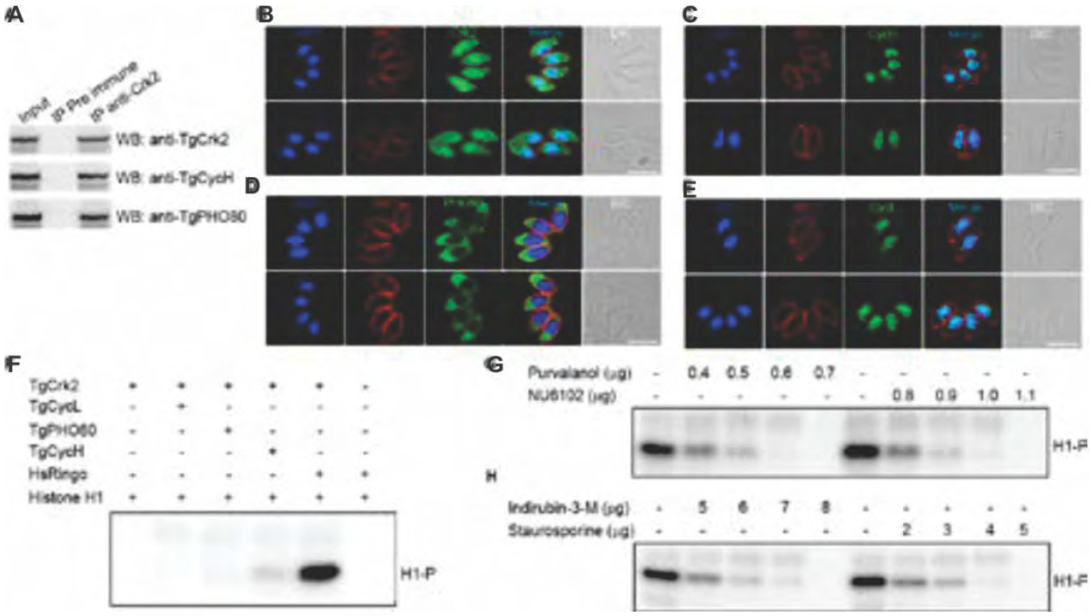


Fig 1. *A. IP using anti-TgCrk2 antibody followed by Western blot with anti-TgCrk2 and anti-TgCycH and TgPHO80 antibodies. B-E. IFA labelling with anti-TgCrk2, anti-TgCycH, anti-TgPHO80, and TgCycL antibodies display nuclear and cytoplasmic, nuclear, cytoplasmic and nuclear localization, respectively. F. Kinase assays were performed using recombinant TgCrk2 in the presence of TgCycH/TgPHO80/TgCycL/HsRingo to test Histone H1 substrate phosphorylation. G and H. The Histone H1 kinase activity of TgCrk2/TgCycH tested in the absence and presence of Purvalanol and Staurosporine.*

Understanding the humoral immune response against cyst stage (chronic phase) antigens

Toxoplasma gondii infection is characterized by an acute phase, associated with the rapidly multiplying tachyzoites, followed by a chronic phase characterized by tissue cyst containing slow-growing bradyzoites. This work focused on studying the humoral immune responses against recombinant and native antigens of encysted bradyzoite and tachyzoite origins. The immunoreactivity of 404 goat, 88 sheep and 92 human sera to recombinant (CST1, SRS9, SAG1, and GRA7) and native proteins of encysted bradyzoite and tachyzoite origins was determined using ELISA, Western blot and immunofluorescence analysis. Both IgM and IgG ELISA results show that nearly 40% of animal and human sera contain *T. gondii* specific

antibodies (Fig. 2A-E). Positive sera predominantly recognized cyst wall (90%) and tachyzoite surface (85%) antigens as demonstrated by IFA (Fig. 2d, E) . Analysis of antibody response against encysted bradyzoites demonstrated that T. gondii IgG-positive but not IgM-positive/IgG-negative sera recognize cyst wall. T. gondii IgM-positive/IgG-negative sera indicate an acute phase infection which was further confirmed using PCR (Fig. 2F). Together, we provide evidence that a robust antibody response against cyst wall antigen is part of the dynamic humoral response towards T. gondii infection.

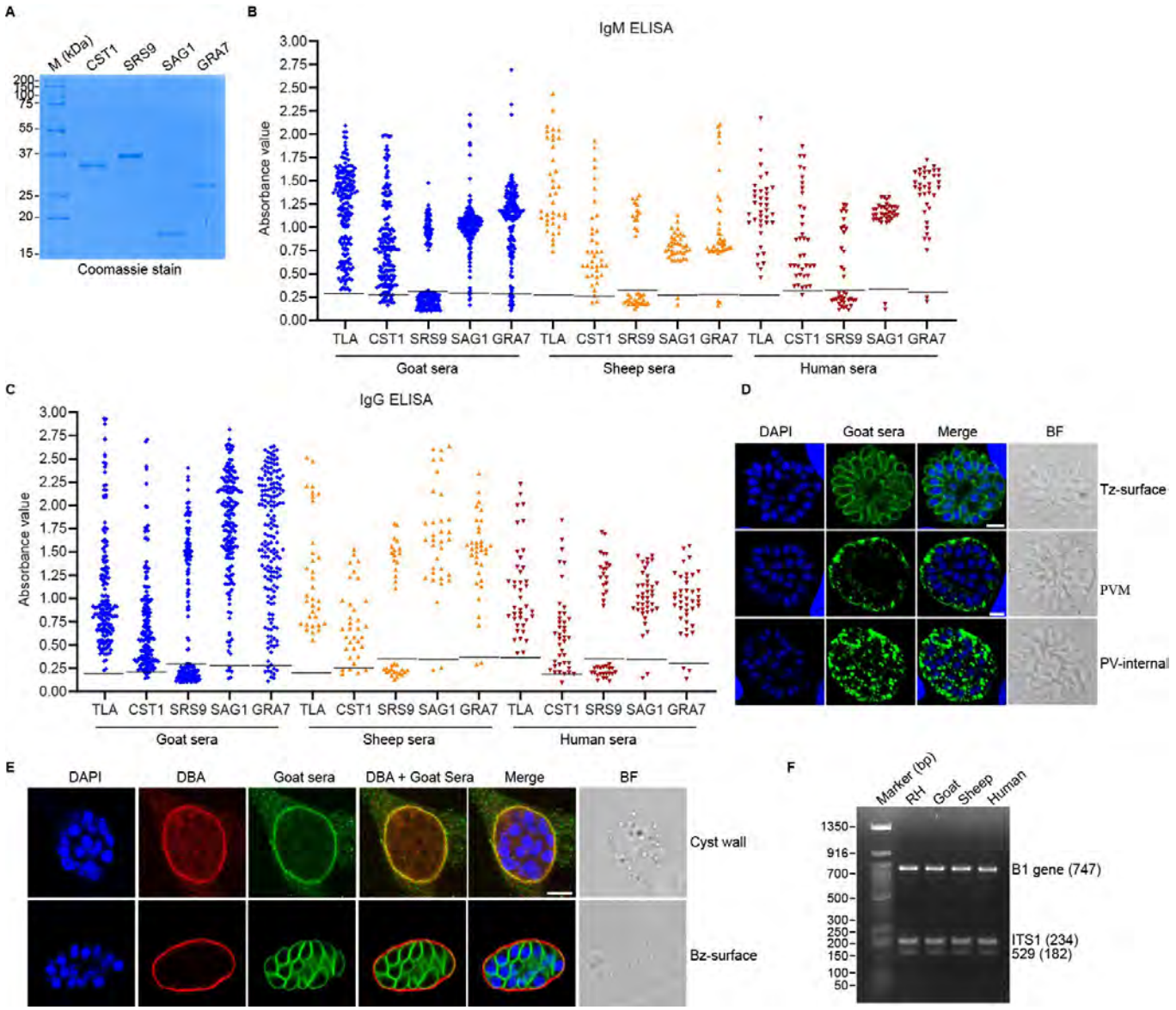


Fig 2. *A. SDS-PAGE profiles of the purified recombinant proteins: CST1, SRS9, SAG1, and GRA7. B and C. Comparison of the immunoreactivities of CST1, SRS9, SAG1, GRA7, and TLA in the IgM and IgG ELISA using goat, sheep and human sera. The horizontal lines represent the cutoff values. D. IFA with T. gondii positive goat sera exhibit two prominent staining patterns viz cyst wall and parasite surface in the bradyzoites. E. IFA with T. gondii positive goat sera exhibit three prominent staining patterns viz parasite surface, PVM and PV-internal in the intracellular tachyzoites. F. Agarose gel electrophoresis of triplex PCR products viz B1 gene, ITS1 and 529 regions. T. gondii RH strain DNA was used as positive control.*

The Lab Photo

Left to Right: Chitti Raju, Abhijit S. Deshmukh, Kalyani Aswale, Nikita Pimpalkar, Bhavana Hebbar, Rajkumar Gurupwar, Poonam Kashyap and Yami Sri

Title: Tuberculosis and Other Zoonotic Diseases of Livestock: Molecular Pathogenesis and Intervention Strategies

Bappaditya Dey

Principal Investigator: **Dr. Bappaditya Dey**

PhD Students:
Rishi Kumar
Prerna Saini

Project Fellows/Trainees:
Repally Ayyanna (ICMR-SRF)

Collaborators

Dr. P. Sharma & Dr. S. Sharma	NIAB, Hyderabad
Dr. U. Sarkar	WBUAFS, Kolkata
Dr. M. Jojula	SSCP, Warangal
Dr. P. Ray & Dr. Al Edwards	University of Reading, UK

Theme and Objectives of Research

Our group works on tuberculosis (TB) and other zoonotic bacterial diseases of livestock in the broad area of molecular pathogenesis, genetic diagnosis, engineered vaccines and therapies. Currently, we are engaged in (A) identification of biomarkers of susceptibility and/or resistance to TB in native and crossbred cattle, and (B) screening for inhibitors of a bacterial enzyme involved in biofilm formation and cell wall homeostasis to develop alternative antibacterial to limit antimicrobial resistance (AMR).

(A) Biomarkers of susceptibility and/or resistance to tuberculosis in native and crossbred cattle.

Tuberculosis (TB) in cattle not only affects the health of animals but also perturbs livestock economy due to reduced production and causing restriction of economic activities involving animal and animal products at local and international levels. Moreover, increasing incidence of TB in human due to M. bovis and that in bovine due to *M. tuberculosis* indicates cattle as a major reservoir of zoonotic TB. As prevalence of TB is markedly greater in exotic and crossbred cattle compared to native breeds in India, this project intends to differentiate the immune responses in native cattle underlying its resistance to TB by transcriptomic approaches. This will not only discover a signature of protective immunity guiding to develop appropriate diagnosis and therapy for TB but also help in adopting appropriate crossbreeding policy. The main objectives are: **i) to differentiate** the influence of breed in the prevalence of *M. bovis* and *M. tuberculosis* infection in cattle in India, **ii) to determine** the influence of breed in the susceptibility and resistance of bovine macrophages to *M. bovis* and *M. tuberculosis* infection, and **iii) to characterize** the transcriptional signature of TB susceptibility and resistance of bovine macrophages from native and crossbred cattle.

During the current reporting period, the following experiments were performed.

- A number of reporter *M. tb* (Ra) and *M. bovis* (BCG) strains were generated expressing GFP, RFP and disRed via episomal plasmids (procured from Addgene). These strains are used for in vitro infection experiments. Calibration of intracellular growth in the in vitro PBMC assay were performed and monitored using High Throughput imaging platform as well as and employing fluorescence multimode readers **(Fig. 1).**
- A number of PCR set up have been standardized to identify as well as differentiate mycobacterial (MTBC, NTM, MTB, BTB) DNA from animal derived samples by a PCR (Fig. 2).
- Pilot experiments has been carried out in collaboration with WBUAFS, West Bengal to compare the response of PBMC from native (Sahiwal) and crossbred (Sahiwal x HF) to M. tb and M. bovis BCG infection in vitro. We have observed marked difference in the induction of IFN-γ response between PBMCs infected with

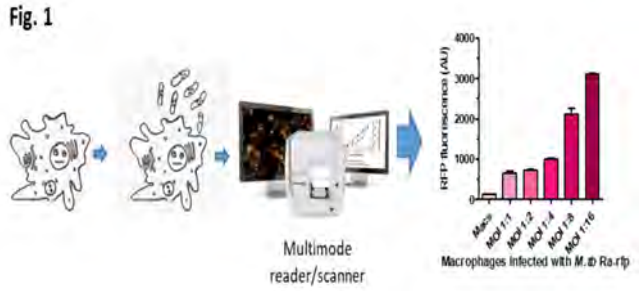


Fig. 1. CFU estimation of M. tb by fluorescence based measurement: *J774 macrophages infected with fluorescence (rfp) M. tb Ra strain at different multiplicity of infection (MOI 1:1 to 1:16) for 3 hours, subsequently washed thoroughly and incubated in fresh culture. Twenty-four hr after infection plates were scanned for fluorescence intensity/well with a multimode reader.*

either M. tb or M. bovis (Fig. 3). As IFN-γ is one of the key cytokines involved in host response to Mycobacterial infection, our observation indicates heightened induction of IFN-γ in the case of Sahiwal might render them less susceptible to **M. tb** or **M. bovis** infection. Currently, real-time PCR based analysis is underway to decipher the molecular events and player involved in this pathway as well as intramacrophage growth assays are underway.

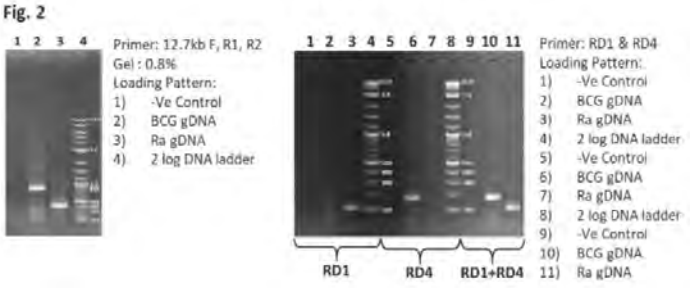


Fig. 3. IFN-γ induction by bovine PBMC infected with Mycobacterium sps.: *Bovine PBMC infected/ stimulated with either M. tb Ra or M. bovis BCG and IFN-γ was measured in the culture supernatant at 24 hr post-infection by ELISA.*

(B) Screening for inhibitors of a bacterial enzyme involved in biofilm formation and cell wall homeostasis to develop alternative antibacterial to limit AMR.

Formation of biofilms is a major contributing factor to the development of antimicrobial resistance (AMR) that prevents effective treatments of a range of bacterial infections posing a serious threat to public health globally. Hence, inhibiting biofilm signaling pathway is a potential approach to develop new classes of

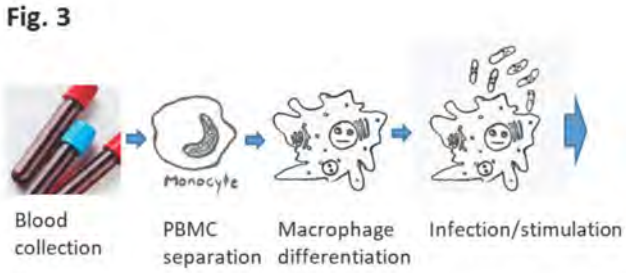


Fig. 2. Calibration of PCR conditions for detection of mycobacterial DNA in animal derived samples. *Representative image of agarose gel electrophoresis of PCR products targeted for detection of M. tb and M. bovis DNA.*

antibacterial that can be used alone or in combination with existing antibiotics. We have identified bacterial di-adenylate cyclase (DAC) as a potential drug target that is involved in biofilm formation and cell wall homeostasis in several medically important bacterial pathogens and intend to identify new Natural Compound (NC) inhibitors of DAC that may augment action of existing antibiotics and prevent evolution of AMR. The main objectives are: (i) to identify Natural Compound (NC) inhibitor of bacterial di-adenylate cyclase (DAC) by structure-based virtual screening, (ii) to evaluate the DAC inhibitory potential of selected NCs by in vitro enzymatic assays, and (iii) to assess effect of shortlisted NCs on growth, biofilm formation and antibiotic susceptibility of selected bacterial pathogens.

During the current reporting period, the following experiments were performed.

- **Structure based virtual screening of NCs for DAC enzyme binding:** By developing intra-institutional collaboration with Dr. Shailesh Sharma- who is a computational biologist, we have screened publically available library of NCs (~18K NCs) against the DisA_N domain containing enzymes of 10 selected bacterial species known to cause diseases in both animals and human and have shown widespread prevalence of AMR (Table-1).

- From ZINC, which is a free database of over 4.6 million commercially available compounds for virtual screening (blaster.docking.org/zinc), we manually selected NC-libraries for screening. These NCs were downloaded from *ZINC database (zinc.docking.org)* in .mol2 format. AutoDock was used to screen compounds using default parameter. Based on binding energies between DAC enzyme and NCs ranking list was prepared of all NCs. Top 10 best fit NCs that exhibited binding to the DisA_N domain were selected for each species of bacteria for subsequent experiments. Further, top 10 common

Sl. No	Phylum	Bacterial Species
1	Firmicutes	*Staphylococcus aureus*
2		*Streptococcus pneumoniae*
3		*Streptococcus pyogenes*
4		*Enterococcus faecalis*
5		*Clostridium perfingens*
6		*Clostridium difficile*
7		*Listeria monocytogenes*
8	Actinobacteria	*Mycobacterium tuberculosis*
9	Chlamydiae	*Chlamydia trachomatis*
10	Proteobacteria	*Klebsiella Pneumoniae*

NCs for more than two selected bacteria were also shortlisted. **Box-1** depicts overall experimental setting. **Fig. 4** depicts a representative image of M. tuberculosis DisA protein and one of the top ranking NCs- ligand complex.

- Cloning of dacA/disA genes of ten relevant bacterial pathogens are underway for purification of DacA enzyme for direct inhibition and other biochemical studies employing the shortlisted natural compound inhibitors as described in the above section. disA gene of *M. tuberculosis* was PCR amplified using *M. tb* genomic DNA as template and cloned into pET-28 protein expression vector. Fig. 5 depicts representative Agarose gel electrophoresis image of the PCR amplification product and confirmation of cloning by enzymatic digestion of the plasmid vector.

Box-1

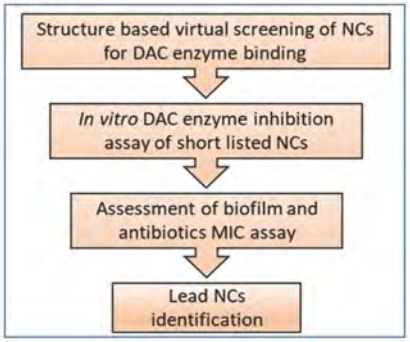


Fig. 4

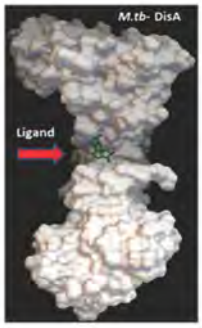


Fig. 5

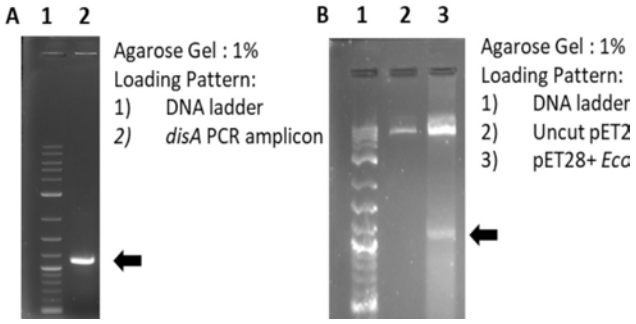


Fig 5. PCR amplification of disA gene of M. tuberculosis and cloning into pET28 protein expression vector.

The Lab Photo

Left to Right : Prerna Saini, Repally Ayyanna, Rishi Kumar, Bappaditya Dey

Research Projects

C. Bioinformatics

Title: Genomics – Structural/ Functional Genomics and Host Pathogen Interaction

G.V.P.P.S. Ravi Kumar

Principal Investigator: Dr. G.V.P.P.S. Ravi Kumar

PhD Students:
Manas Ranjan Praharaj

Project Fellows:
Neelima (NPDF)
Vykuntam Naga Gowthami (Project Associate - II)

Trainee
Vedasree Pallikonda

Collaborators:

Dr. Subeer S Majumdar	NIAB, Hyderabad
Dr Sarwar Azam	NIAB, Hyderabad
Dr. Satya pal Arya	NIAB, Hyderabad
Dr Benjamin D Rosen	USDA, USA
Dr. Curtis P Van Tassell	USDA, USA
Dr. Gyanendra Singh	IVRI, Bareilly

Objectives

1. To develop a Bos indicus SNP chip for identification of purebreds/admixture in indigenous cattle (Project - Genomics for conservation of indigenous cattle breeds and for enhancing milk yield, Phase-I)
2. Gene expression profiling in Tharparkar and crossbred under heat stress (Project - Identification of unique factors in indigenous livestock making them resilient to climate change in relation to diseases)
3. To identify molecules that are responsible for differential response to Japanese encephalitis virus in different hosts - Pig and human (Project - Genomics assisted pathobiology to identify novel targets for diagnosis and therapeutic intervention(s) of Japanese encephalitis and Leptospirosis)

Theme of Research : Genomics and Host Pathogen interaction

Work Reported in 2018 -19

Progress of work during the current reporting year (2018-2019)

1. To develop a Bos indicus SNP chip for identification of purebreds/admixture in indigenous cattle

   Blood samples from 16 breeds collected making it a total of 27 breeds.
2. Gene expression profiling in Tharparkar and crossbred under heat stress

Differentially Expressed Genes (DEGs) were identified in both Crossbred and Tharparkar.Considering HSP70 regulating pathway (Jordan Thomas silver 2012) and proinflammatory cytokine production pathway (Hitesh N Pawar et al., 2014), 89 genes were selected based on their role in heat response. Out of these genes, 32 and 36 genes were found to be unique in Tharpakar and Crossbred, respectively and 28 were found to be common. Major proteins related to heat response viz. HSPA4 with degree of 64, TRAF6 with degree of 96, TRAF2 with degree of 81, IRAK1 with degree of 42 and BAG2 with degree of 24 were depicted in predicted Differentially Expressed Highly Connected (DEHC) network of unique DEGs with all DEGs of Tharparkar. Similarly in Crossbred, the network of unique DEGs with whole DEGs had proteins viz. HSPA5, IRF3, GSK3A and BAG4 highly connected with a degree of 36,

14, 9 and 7 respectively. In DEHC networks of unique common DEGs with all DEGs of crossbred and unique common DEGs with all DEGs of Tharparkar proteins viz. ILK, TRAF1 and ICAM1 are hub. The RNA-seq data were validated by using primers of 9 important candidate genes (HSPA4, CAMK2D, HSPA5, GSK3A, NFKB2, SIRT1, ICAM1, HSPB8, MYD88) involved in regulation of HSF or HSP proteins. GAPDH was used as endogenous control.

Progress of work during the current reporting year (2019-2020)

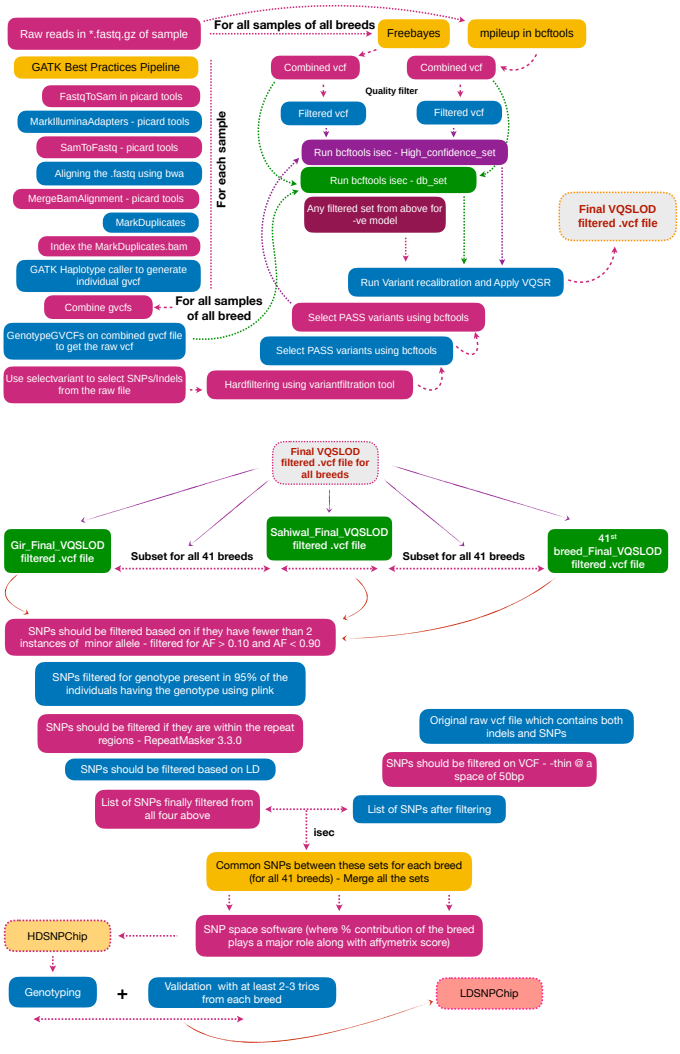
1. To develop a Bos indicus SNP chip for identification of purebreds/admixture in indigenous cattle

Background

Crossbreeding was successfully practiced extensively in India to meet the milk demand. However, this resulted in dilution of our indigenous germplasm that have specific characteristics of being heat tolerant and disease resistant. With Global warming on the rise it becomes inadvertent to identify the admixture in our indigenous breeds to further conserve the purebreds. For this genetic characterization, the available technologies in the market – Bos taurus HDchip, microsatellite analysis, etc., would not suffice the need. Therefore, developing a Bos indicus HDchip is the need of the hour. In this ongoing project, whole genome sequencing of all 43 breeds is taken up on Illumina platform. The 30X data from 176 samples (20 animals, each of five major breeds - Gir, Tharparkar, Kankrej, Red Sindhi and Sahiwal ; and 2 animals, each of other 38 breeds) has been generated. The data generated is being analyzed to identify SNPs that would be placed on chip for further use to delineate admixture in cattle available in field and organized farms.

Key Achievements :

- Blood samples of 43 breeds have been collected - A total of 2117 samples collected till date. Samples were collected from all over India within a period of 8 - 11 months. DNA from these samples was isolated
- Whole genome sequence data (coverage ~ 30X) of 176 animals was generated. This included 20 animals, each of five major breeds - Gir, Tharparkar, Kankrej, Red Sindhi and Sahiwal ; and 2 animals, each of other 38 breeds (total 43 breed's representation).
- The 30X data generated for each animal of all the breeds is being run through the GATK, freebayes and mpileup pipelines with an aim to develop HD SNPchip by April, 2020
- The process for fabrication of SNP chip has been initiated.
- One male each, from the major breeds mentioned above was selected based on the its history/ pedigree records and the DNA from these animals was sent for sequencing (10X genomics) with an aim to assemble the whole genome of the Major breeds - Gir, Tharparkar, Kankrej, Red Sindhi and Sahiwal
- The draft genome of these major breeds has been assembled
- One elite Sahiwal Bull - Ganesh, known for its productivity has been selected for complete Bos indicus whole genome sequencing (Pacbio, Optical mapping, Hi-C)



2. Gene expression profiling in Tharparkar and crossbred under heat stress

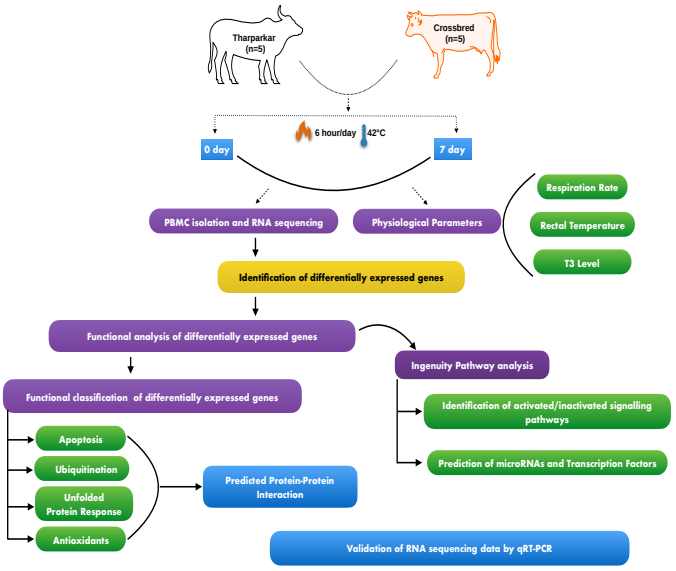
Background

Heat stress induced by high environmental temperature and humidity affects livestock production and health. With global warming on the uprise, indigenous cattle known for their heat tolerance are gaining importance than the crossbreds. However, systems biology behind this phenotype in indigenous cattle is less known. In this study using transcriptome analysis, we identified key molecules and pathways that may lead to the heat tolerance phenotype in indigenous cattle (Tharparkar breed)

Key achievements

- The number of DEGs in Crossbred were found to be more than in Tharparkar suggesting a greater dysregulation in systems biology in Crossbred.
- A contrast in gene expression was observed with 18.5 % of upregulated genes in Crossbred (Vrindavani cattle) downregulated in Tharparkar and 17.5% upregulated genes in Tharparkar downregulated in Crossbred.
- The increased HSPs levels have been found positively correlated with tolerance in many species. Upregulation of HSF, HSP70, HSP90, and activation of eIF2 signaling pathway in Tharparkar and vice-versa in Crossbred delineates how Tharparkar withstands heat stress.
- Unlike Crossbred, Tharparkar is not only endowed with higher expression of the scavengers (UBE2G1, UBE2S, and UBE2H) of misfolded proteins but also with protectors (VCP, Serp1, and CALR) of naïve unfolded proteins.
- Further, the apoptotic genes that were dysregulated in both genetic groups indicated a relatively higher probability of apoptosis in Crossbred than in Tharparkar. Also, higher expression of the antioxidants in Tharparkar enables it to cope up with higher levels of free radicals generated as a result of heat stress.
- In this study we found relevant molecules/genes dysregulated in Tharparkar in the direction that can counter heat stress. To best of our knowledge this is a comprehensive comparison between Tharparkar and crossbred at a global level using transcriptome analysis.

Work flow



3. To identify molecules that are responsible for differential response to Japanese encephalitis virus in different hosts - Pig and human

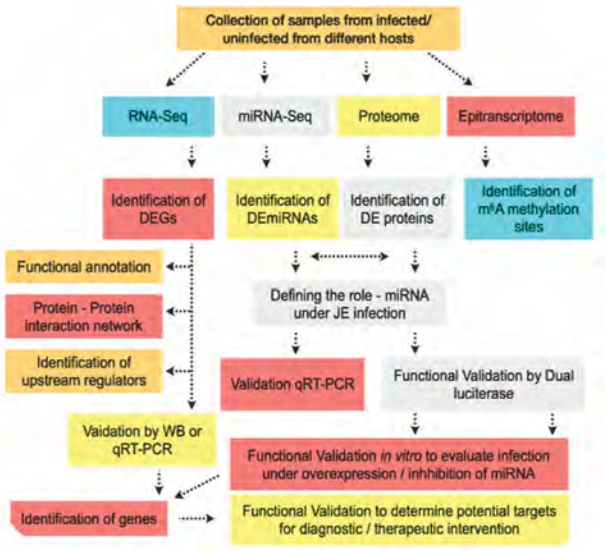
Background

Viremia is caused by the replication of viruses which results in viruses being introduced into the bloodstream. Domestic pigs are the major amplifying host for Japanese encephalitis (JE) virus transmission to humans, because they develop high titers and long-lasting viremia after natural infection. Humans, horses, and other non-avian vertebrates are considered dead-end hosts because they do not produce a level of viremia sufficient to infect new mosquitoes. With high titers of virus in the blood, Pigs rarely show symptoms and humans with low levels of the virus in blood are affected. This differential host response will be explored by transcriptome (mRNA, mIRNA, LncRNA, epitrancriptome and Circular RNA) and Proteome analysis in the project that is taken up at our Institute. At our end, we are able to collect samples from Pigs infected with JE. This alone would not suffice the need as we have to study the differential response in both the hosts - Pigs and Human.

Workplan

Key achievements :

- Linkage meeting was held on July 26 and 27, 2019, to establish linkages for collection of human and pig samples



- Pig sample tested positive for JE were received from IVRI were confirmed for JE infection by Real - Time PCR
- Invitro studies with the vaccine virus are underway.
- Several equipment have been purchased in the project and the lab established

Future Plan

- The whole genome data will be be analyzed and Bos indicus HDSNPchip will be developed. All breeds will be genotyped and the data will be analyzed.
- Transcriptome data for Invivo and Invitro studies will be generated to identify the systems biology behind the differential response of host to JE virus.

Publications

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2. Pesingi P V, Singh B R, Pesingi P K, Bhardwaj M, Singh S V, Kumawat M, Sinha D K, **Gandham R K. 2019**. MexAB-OprM Efflux Pump of Pseudomonas aeruginosa Offers Resistance to Carvacrol: A Herbal
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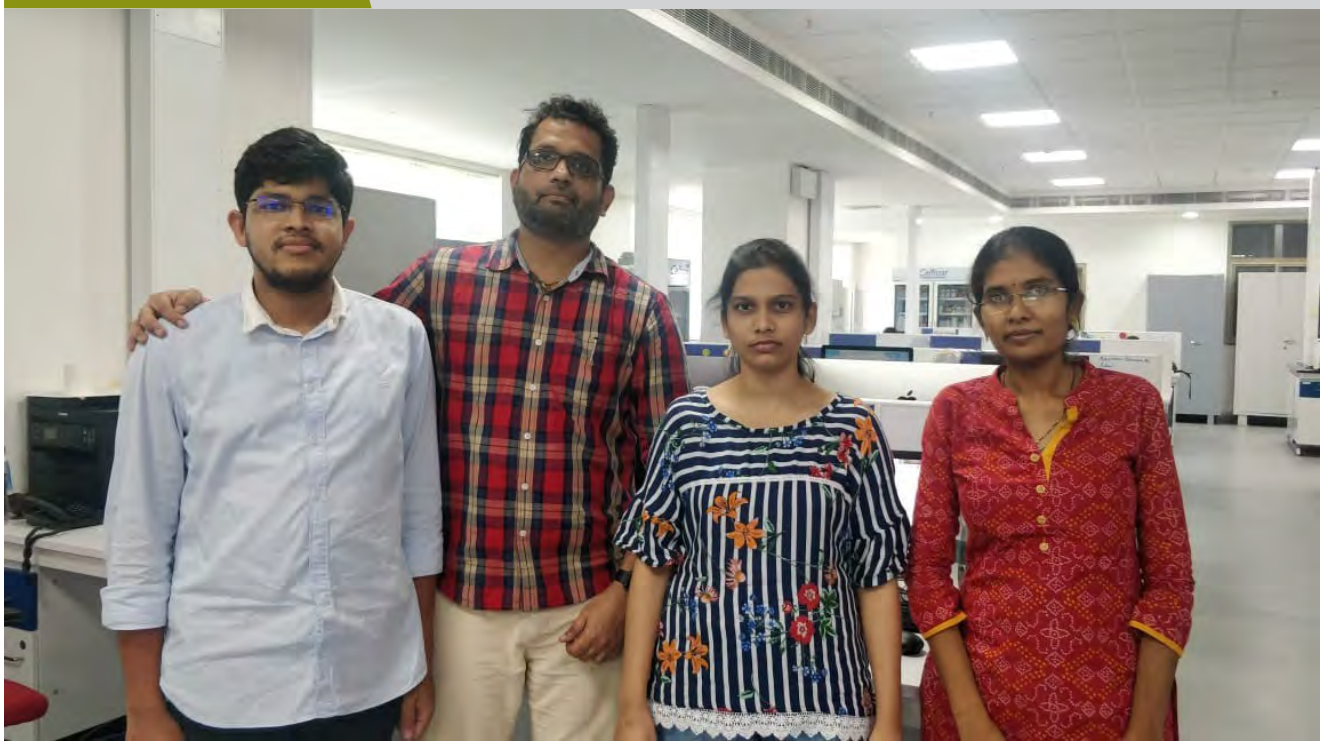
5. Sinha R, Sahoo N R, Shrivastava K, Kumar P, Qureshi S, De UK, Kumar A, **Kumar G**., Bhushan, B. Resistance to ETEC F4/F18-mediated piglet diarrhoea: opening the gene black box. Trop Anim Health Prod 2019; 51:1307-20

The Lab Photo



Left to Right: Manas Ranjan Praharaj, Ravi Kumar Gandham, Tejaswi Ambati & Neelima Hosamani

Title: Unlocking genomics potential for increased nutrition and productivity

Shailesh Sharma

Principal Investigator: **Dr. Shailesh Sharma**

PhD Students:
Venkata Krishna Vanamamalai
Itishree Jali

Project Fellows/Trainees:
Priyanka Garg (Since September 2019)

Collaborators:

Dr. Vishesh Kumar Saxena	CARI, Izatnagar
Prof. B Senthilkumaran	UoH, Hyderabad
Dr J. P. Pandey	CTR & TI, Ranchi.
Dr. Gautham Kolluri	CARI , Izatnagar

Theme of Research

Our team's research experience span bioinformatics and structural biology, including application of data mining, application of bioinformatics tools, computational biology, and structure-activity relationships. Present work includes (a) identification of lncRNAs during host responce against NDV. (b) investigations into structural, functional and dynamic properties of proteins. (b) genome annotation, protein structure, target identification, and molecular dynamics simulations.

Presently we are working on following projects:

1. Sequencing of whole genome of tasar silkworm, *Antheraea mylitta*, funded by DBT.
2. Rerouting of FSH and LH by natural products to enhance the follicle survival and ovulations in mouse and livestock parallel studies.
3. Analysis of RNA-Seq Data to infer key molecular players involved during host response to Newcastle disease virus challenge in transcriptome of *Gallus gallus domesticus* in Aseel, Nicobari, Kadaknath, Fayoumi and Leghorn.

Objective

1. Sequencing of whole genome of tasar silkworm, *Antheraea mylitta,* funded by DBT.
    1. To perform the whole genome sequencing of *A. mylitta*
    2. To study the molecular basis of different qualitative and quantitative traits of *A. mylitta* through whole genome sequencing.
    3. Transcriptome and proteome analysis of relevant tissues related to silk production.

Funded by DBT

2. Rerouting of FSH and LH by natural products to enhance the follicle survival and ovulations in mouse and livestock parallel studies.
    1. Screening of natural compound libraries
    2. Study the effect of top hits on FSH and LH activity in mouse and goat
    3. Study the effect of FSH and LH on ovulations, follicle survival and litter size
3. Analysis of RNA-Seq Data to infer key molecular players involved during host response to Newcastle disease virus challenge in transcriptome of *Gallus gallus domesticus* in Aseel, Nicobari, Kadaknath,

Fayoumi and Leghorn.

1. To perform transcriptomic sequence data analysis of Leghorn and Fayoumi breed
2. To carry out RNA sequencing of Harderian glands, trachea, lung, kidney, spleen, heart, brain and intestine tissue samples from the three indigenous breeds Aseel, Nicobari and Kadaknath or Kali Masi.
3. To explore deferentially expressed significant mRNAs and non-coding RNAs (ncRNAs) across breeds
4. To construct ncRNAs targeted gene co-expression network

Work Reported in 2018-2019

1) Sequencing of whole genome of tasar silkworm, *Antheraea mylitta:*

Mapping of Antheraea mylitta reads:

The shallow sequenced data of *Antheraea mylitta* is analysed for quality by using FastQC tool. After that adapters were trimmed by using Trimmomatic tool. The reads of *Antheraea mylitta* were mapped with the genome of sericiginous insects (i.e. *Antheraea yamamai, Bombyx mori, Bombyx mandarina*) and non-sericiginous insects (i.e. *Danaus plexippus, Melitaea cinxia, Drosophila melanogaster, Aedes aegypti*). The mapping of reads of *Antheraea mylitta* was performed by Bowtie2 tool and 237976 reads of *Antheraea mylitta* were mapped to *Antheraea yamamai*, 1042788 reads of *Antheraea mylitta* were mapped to *Bombyx mori* and 1004095 reads of Antheraea mylitta were mapped to Bombyx mandarina. Similarly, 56100, 460741, 64069 and 591999 reads of *Antheraea mylitta* were mapped to *Aedes agypti, Danaus plexippus, Drosophila Melanogaster* and *Melitaea cinxia* (Table a to f).'

Antheraea yamamai (a)	
Mapped Sequence	237976
Mapped Percentage	0.20%
Perfect Paired	113017799
Perfect Paired Percentage	100.00%
Mismatches at 0 times	112827461
Mismatches Percentage at 0 times	99.80%

Bombyx mori (b)	
Mapped Sequence	1042788
Mapped Percentage	0.64%
Perfect Paired	113017799
Perfect Paired Percentage	100.00%
Mismatches at 0 times	112626267
Mismatches Percentage at 0 times	99.40%

Bombyx mandarina (c)	
Mapped Sequence	1004095
Mapped Percentage	0.60%
Perfect Paired	100.00%
Perfect Paired Percentage	113017799
Mismatches at 0 times	112677156
Mismatches Percentage at 0 times	99.40%

Aedes agypti (d)	
Mapped Sequence	56100
Mapped Percentage	0.03%
Perfect Paired	113017799
Perfect Paired Percentage	100.00%
Mismatches at 0 times	113011241
Mismatches Percentage at 0 times	99.07%

Danaus plexippus (e)		
Mapped Sequence	460741	64069
Mapped Percentage	0.33%	0.03%
Perfect Paired	113017799	100.00%
Perfect Paired Percentage	100.00%	113017799
Mismatches at 0 times	112779072	113012836
Mismatches Percentage at 0 times	99.77%	99.07%

Melitaea cinxia (f)	
Mapped Sequence	591999
Mapped Percentage	0.39%
Perfect Paired	100.00%
Perfect Paired Percentage	113017799
Mismatches at 0 times	112784591
Mismatches Percentage at 0 times	99.61%

Table a to f: *The tables arer showing the mapping results of Antherea mylitta to the respective sericigenous and non sericiginous genomes.*

Single Nucleotide polymorphism (SNP) Identification:

Bombyx mori is the well-studied sericigenous insect. We identified the SNPs in *Antherea mylitta* against *Bombyx mori* as a reference genome. Apart from this, SNPs in two other sericigenous insects i.e. *Antheraea yamamai* and *Bombyx mandarina* which were least studied as compared to *Bombyx mori* were also identified against *Bombyx mori* as reference genome. The SNPs identification was done by using three tools that are GATK pipeline, Mplieup and freebayes of these three sericigenous insects against *Bombyx mori*. In *Antherea mylitta*, 263180, 482724 and 349653 SNPs were found by using three different tools i.e. GATK, mpileup and freebayes respectively. In *Antheraea yamamai*, 1541, 3242 and 4031 SNPs were found by using three different tools i.e. GATK, mpileup and freebayes respectively. In *Bombyx*

mandarina, 318474, 55 and 424415 SNPs were found by using three different tools i.e. GATK, mpileup and freebayes respectively (Table g to i). We extracted the SNPs of *Antherea mylitta*, *Antheraea yamamai* and *Bombyx mandarina* against *Bombyx mori* which were commonly reported by these three tools. Moreover, we plotted the localization of common SNPs of all three sericigenous insects against the chromosomes and known genes of *Bombyx mori* by using Circos tool (Figure 1).

***Anthearea mylitta* against *Bombyx mori* (g)**	
GATK	263180
mpileup	482724
freebayes	349653

Table g to h: SNPs identification of *Antherea mylitta*, *Antheraea yamamai* and *Bombyx mandarina* against *Bombyx mori* by using three tools that are GATK, mpileup and freebayes.

Common SNPs Between three tools: GATK,Mpileup,freebayes (h)	
Anthearea mylitta against *Bombyx mori*	115619
Anthearea yamamai against *Bombyx mori*	1248
Bombyx mandarina against *Bombyx mori*	227209

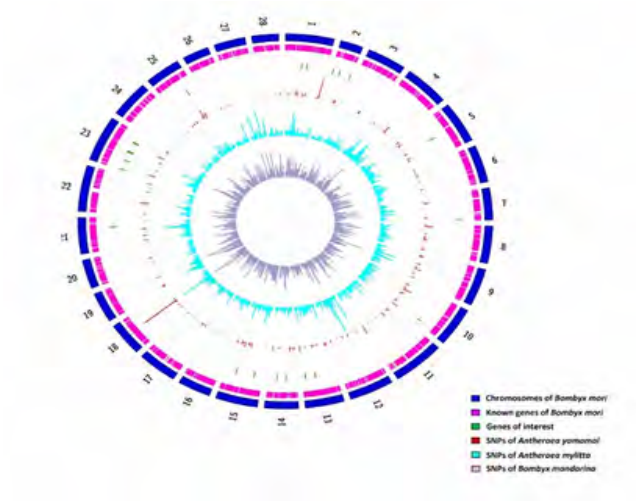


Figure 4: *Circos plot showing the SNPs identification of three different sericigenous insects against Bombyx mori.*

Bombyx mandarina against Bombyx mori (i)

GATK	318474
mpileup	55
freebayes	424415

Table i: Common SNPs of all three sericigenous insects against Bombyx mori which were commoly reported by three tools that are GATK, mpileup and freebayes

2) Rerouting of FSH and LH by natural products to enhance the follicle survival and ovulations in mouse and livestock parallel studies.

We have screened 20000 natural compounds from Zinc database. Ranked them based on the binding energies with FSH (Fig 2). Top and last ranked commercially available compounded were ordered, injected to swiss albino mice and collected the serum to check the FSH levels every one hour for 12hrs.

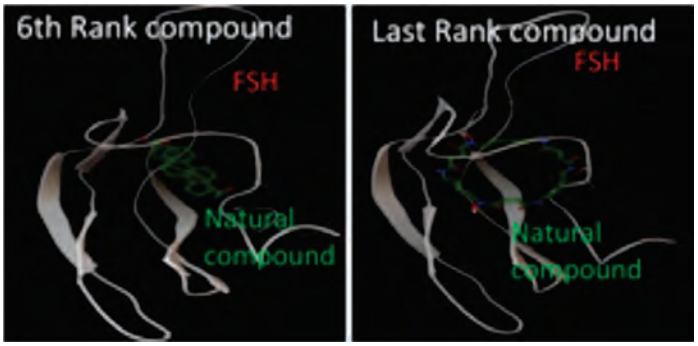


Fig2: Binding images of 6th rank compound and last rank compound. Natural compound in green color.

3. Progress of work during the current reporting year (2019-2020)

Analysis of RNA-Seq Data to infer key molecular players involved during host response to Newcastle disease virus challenge in transcriptome of Gallus gallus domesticus in Aseel, Nicobari, Kadaknath, Fayoumi and Leghorn.

Long non-coding RNAs (lncRNAs) are the transcripts longer than 200 nucleotides length that are dynamic regulatory molecules. Using bioinformatics approaches, we identified and characterized lncRNAs during host response to Newcastle disease virus challenge in transcriptome of *Gallus gallus domesticus* in Leghorn and Fayoumi breeds by analyzing RNA-seq data from EBI-ENA database for Harderian gland. We conducted differential expression analysis and determined the potential role of lncRNAs for the first time in Leghorn and Fayoumi breeds of *Gallus gallus domesticus*. Functional annotation using co-expression analysis revealed their involvement in regulation of various pathways. Additionally, we identified lncRNAs as putative miRNA precursors and the interaction of lncRNAs with transcription factors. In brief, these transcripts coordinate important biological functions via interactions with both coding and non-coding RNAs as well as Transcription Factors during host response against Newcastle disease virus

challenge in Leghorn and Fayoumi breeds of *Gallus gallus domesticus*. Our study would facilitate future experiments in unravelling regulatory mechanisms of development in this genetic improvement of the two breeds of *Gallus gallus*.

Future Plans

1) Sequencing of whole genome of tasar silkworm, Antheraea mylitta.

   In th this project we will perform the transcriptome analysis, preparation of final assembly and development of genome browser.

2) Rerouting of FSH and LH by natural products to enhance the follicle survival and ovulations in mouse and livestock parallel studies.

We would like to screen the natural compounds which interact with FSH specifically at C terminus. Based on our preliminary screen we found that the compounds are effective on FSH secretion. In the study we are trying screen large scale publicly available natural compounds. After screening and ranking the natural compounds by bio informatic tools the highest and lowest ranked compounds will be injected to mice and goat to check the FSH/LH regulations.

The Lab Photo

Left to Right: Priyanka Garg , Itishree Jali, Shailesh Sharma, Venkata Krishna Vanamamalai

Title: Marker Discovery and Comparative Genomics

Sarwar Azam

Principal Investigator: Mr. Sarwar Azam

Collaborators:

Dr. Subeer S Majumdar	NIAB, Hyderabad
Dr. Ravi Kumar	NIAB, Hyderabad
Dr. Satya pal Arya	NIAB, Hyderabad
Dr. Syed Faisal	NIAB, Hyderabad
Dr. Benjamin D Rosen	USDA, USA
Dr. Curtis P Van Tassell	USDA, USA

Theme of the scientific activity: The research includes analysing sequence data for genome annotation, gene expression, identifying single nucleotide morphism (SNPs), comparative genomics, phylogenomics and other evolutionary analysis. Lab has also been interested in developing easy to use bioinformatics tools and pipeline to facilitate genomic studies.

Genomics for conservation of indigenous cattle breeds and for enhancing milk yield

Sample collection

In continuation to previous year effort, we collected 732 new samples which included 17 additional breeds this year. So totally we collected 2117 samples from all the 43 breeds. LGPMIS, storing all the sample related data has been updated. Statistic of collected sample are summarized in Figure 1. Least number of samples has been collected from Lakhmi breed whereas maximum samples has been collected from Tharparker.

Data generation

All breeds (43) of indigenous cattle were covered in sequencing. 20 individuals of each milch breed and 2 samples from rest of the breeds were sequenced using Illumina HiSeq X. So a total of 176 individual were sequenced. Each sample were sequenced with coverage of 30X. This produced 24241.3 Gb of data. All data produced were in pair end (150X2) format.

Data analysis

All data were processed for SNPs identification. The tools used for analysis were Fastp, BWA, Samtools, VCFtools, GATK, Freebayes, etc. Most of the pipeline were written in bash scripts. A total of 145286.81 M clean reads were obtained which amount to 20005.93 Gb data. These were aligned to Brahman Refrence genome (https://www.ncbi.nlm.nih.gov/assembly/GCF_003369695.1) for SNP identification. As per Freebayes SNP discovery program, 48.1M SNPs were annotated across all the breeds. A total density of 17.9

SNPs per 1000bp were observed. Maximum density was found on chromosome "NC_04098.1". Further analysis of SNP data for developing genotyping chip are underway.

Developing de novo genome assemblies of milch breeds of cattle i.e. Kankrej, Tharparker, Red Sindhi, Sahiwal and Gir

The de novo genome assemblies of milch breeds will be pivotal in exploring gene function, genome evolution and improving genetic breeding. All five milch breeds of India are from different native tracts and shows very high phenotypic variations. Characterizing their genome assemblies will extract genotypic variations which generally cannot be capture by SNPs such as large-scale chromosomal rearrangements. The impact of a chromosome-scale and haplotype-phased genome has been established in terms of unique probe alignment, genetic architecture of the traits, candidate gene mining, and genomic prediction.

Data generation:

Representative samples from each breed of Tahrparker, Gir, Sahiwal, Red Sindhi and Kankrej has been subjected to Chromium 10x Gemcode technology using 10X Genomics platform for library preparation. Further, these samples were sequenced using Illumina HiSeq X. On average 100X data has been produced for each sample.

Data analysis:

Supernova assembler version 2.1.0 were used to assemble all the samples prepared using 10X Genomics platform. Four draft assemblies has been generated till now (Table 1). These assemblies are of Tahrparker, Gir, Sahiwal and Kankrej. All assemblies are in the range of 2.58 Gbp to 2.62 Gbp. Largest assemblies were belongs to Gir breed. Scaffold N50 of Sahiwal assembly were 59 Mbp which very very high in comparison to other assemblies. Scaffold N50 of other assemblies are less than 1 Mbp. These assemblies are little smaller than known genome assembly of humped cattle Brahman (2.68 Gbp). Further, comparasion of these draft with each other and with assembly of exotic breeds are under process.

Exploring Leptospira genomes for phylogenetic analysis and vaccine candidate selection

Data collection and genome sequences of Leptospira species:

As per NCBI database, a total of 624 genomes are sequenced representing 73 species. Maximum of 305 genomes were sequenced from L. interrogans followed by L. borgpetersoni (44). In fact, Leptospira genomes reported and sequenced from more than 40 countries. Maximum number of genomes sequenced were from brazil and china. Most of these sequenced are isolated from human host followed by Cattle.

Similarity and distances between Leptospira genomes:

All representative genomes excluding L. Macculloughii was compared with each other for genomic similarity. ANIb values showed that each species have at least 68% nucleotide identity. *Leptospira ryugenii* and *leptospira santrosi* showed least nucleotide identity (68.92%). Hierarchical clustering on basis of ANI value clearly depicts 4 groups. However, 8 pairs of genomes showed more than 95% average nucleotide identity apart from self-compared genomes showing 100% nucleotide identity. Closeness of leptospira species were further checked using insilico DNA-DNA hybridization (DDH). We found 5 pairs of genomes showed more than 70% hybridization.

Analyses of core and pan genomes:

To assess the diversity in gene content of leptosipra genus, core and pan genome of 72 leptospira representative species were calculated. The pangenome of leptospira never saturated and increased with 91 genes, even after the addition 72th species. Therefore pangenome of Leptospira remain open. However, core genome decreased drastically with addition of initial few genomes and started stabilizing after addition of 51th genome. At the end , core genome graph become parrellel to X axis, and thus, core genome can be considered as closed one. Pangenome consist of 20822 gene where as core genome consist of 1038 genes and Soft-core genome consist of 1848 genes. Accessory genome consisting 6488 genes (31.1%) in the shell 12486 genes (59.9%) in cloud.

A core genome based hierarchical clustering revealed 3 optimal cluster on basis of average silhouette width. These three clades were designated as pathogenic, non-pathogenic (saprophytic) and intermediate clades on the basis of nature of most of the species grouped in clad. The hierarchical clustering on the basis of soft -core and pangenome also produce 3 clades and same species in each clad. The largest

clad was non-pathogenic clad, clustered with 26 species followed by pathogenic clad consisting 24 and intermediate clad with 22 species. When compared with hierarchical clustering using ANIb value, five species *L. ryugenii, L. ognonensis, L. idonii, L. ilyithenensis* and *L. kobayashii* changed the grouping. Each clad were separately grouped and analysed for core, soft-core and pan genome. Largest pangenome was of pathogenic clad (12416 genes) whereas largest Core and soft-core genome was of Intermediate clad. Pathogenic has significantly smaller core genome (11.9%) and soft-core genome 19.3% in comparison to other clads. Comparatively, cloud genes contributed higher proportion (56.9%) in pangenome of pathogenic clad.

Phylogenomic analysis of Leptospira genomes:

Core genome of leptospira genus comprised of 1038 genes. 946 genes were of them were found to be single copy orthologs and rest 73 genes are multi-copy orthologs. All single copy orthologs were concatenated and analysed to establish the phylogenetic relationship among *Leptospira* species. When *leptonima ilinii* was included as outgroup, single copy orthlogs across all the species decreased to 705 genes. However, branching pattern in both phylogenetic trees were same. The clustering of species in 3 phylogenetic groups was identical to the 3 clades of dendrograms obtained from core, softcore and pangenome clustering. The three phylogenetic clad represented with different colour in Figure 2 can be called pathogenic (maroon), intermediate (blue) and non-pathogenic clad (green) respectively. Each branch of tree was supported very high Bootstrap value (100). Phylogenetic grouping of species differs with grouping of species using ANIb value. The 5 species i.e. again grouped with non-pathogenic species rather than intermediate species as in ANIb hierarchical clustering.

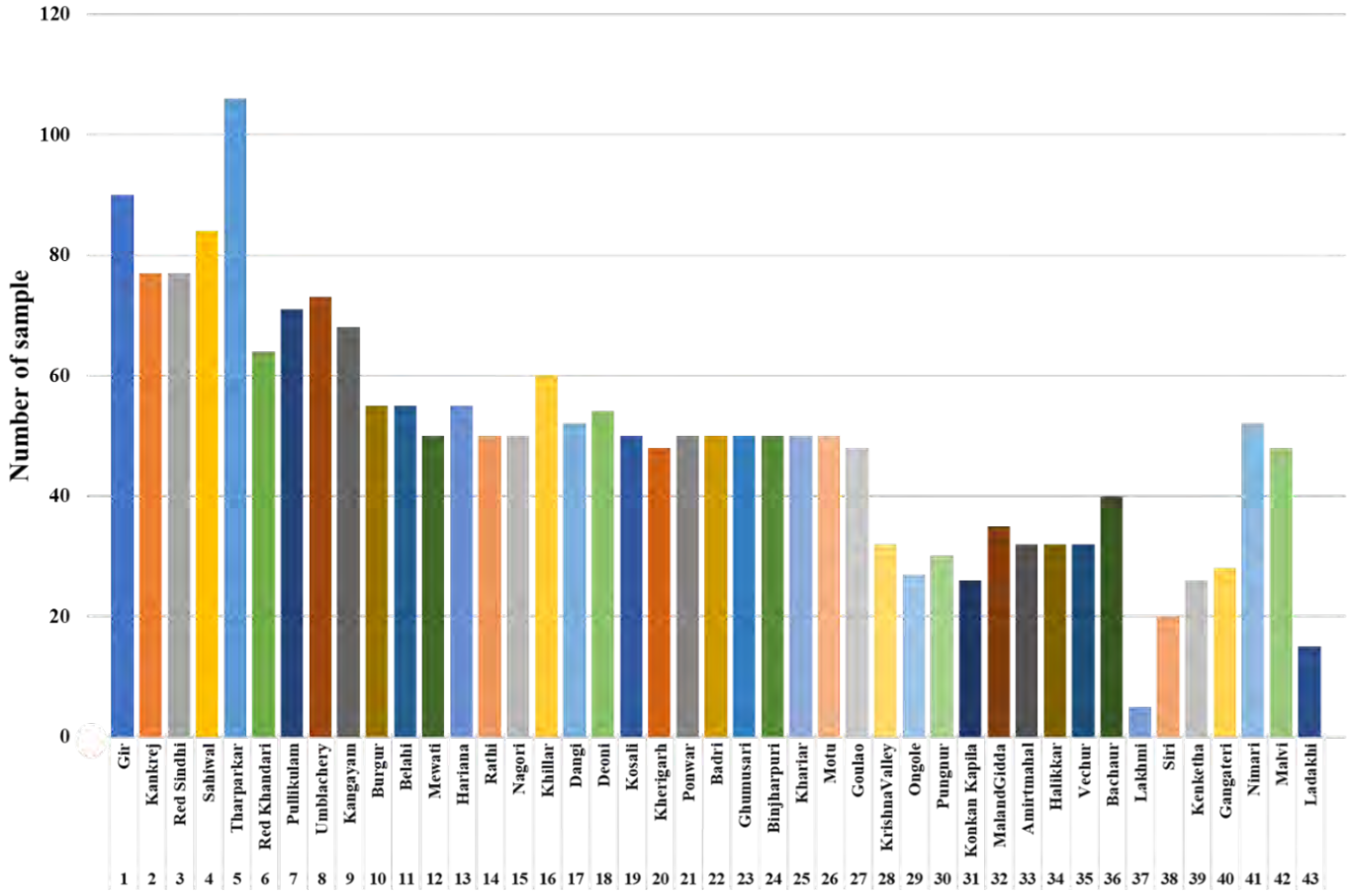


Fig 1: Breed-wise samples collection for genotyping and sequencing

Table 1: Statistics of draft genome of milch breeds

Assembly statistics	Gir	Kankrej	Tharparkar	Sahiwal
Total size (bp)	2.62 Gb	2.58 Gb	2.59 Gb	2.58 Gb
SCAFFOLD N50				
(N50 scaffold size)	846.55 Kb	1.20 Mb	862.89 Kb	59.70 Mb
LONG SCAFFOLDS				
(number of scaffolds >= 10 kb)	12.26 K	9.63 K	11.21 K	2.50 K
EDGE N50				
(N50 edge size)	17.18 Kb	15.86 Kb	15.50 Kb	28.56 Kb
CONTIG N50				
(N50 contig size)	110.71 Kb	170.85 Kb	132.05 Kb	182.91 Kb
PHASEBLOCK N50				
(N50 phase block size)	601.27 Kb	677.57 Kb	612.38 Kb	4.72 Mb
MISSING 10KB				
(% of base assembly missing from scaffolds >= 10 kb)	3.73 %	2.76 %	4.25 %	2.45 %

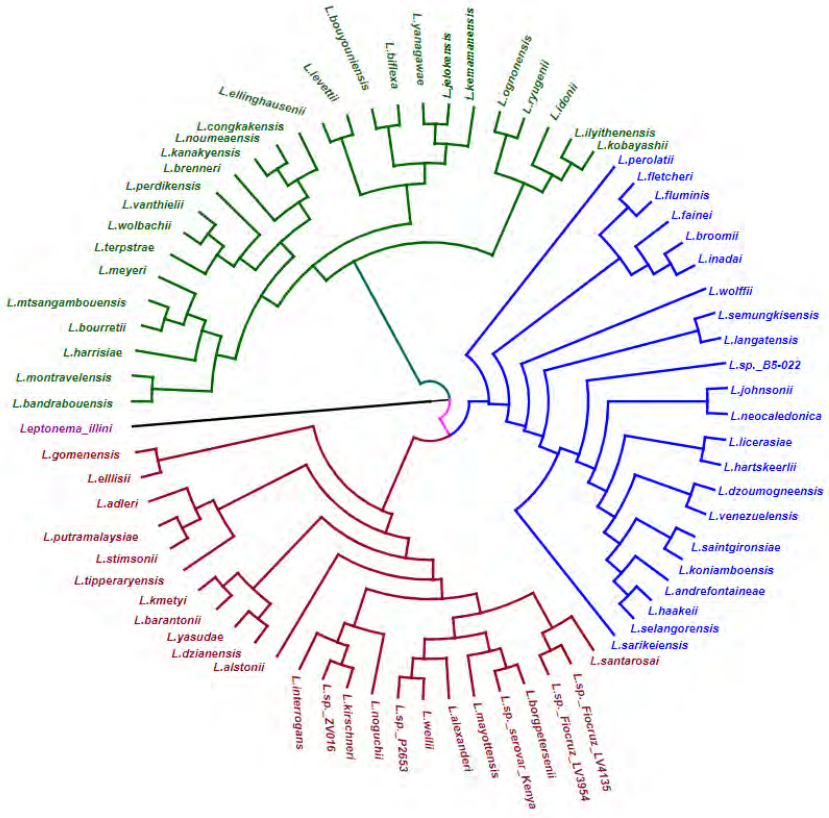


Fig 2: Phylogenetic core genome tree of Leptospira species using maximum likelihood. The tree is rooted with Leptonema Illini.

Publications

1. Azam, Sarwar, et al. "Genome Organization and Adaptive Potential of Archetypal Organophosphate Degrading Sphingobium fuliginis ATCC 27551." Genome biology and evolution 11.9 (2019): 2557-2562.

Title: Quick diagnostics/therapeutics using smart nanomaterial for animal welfare

Sonu Gandhi

Principal Investigator: Dr. Sonu Gandhi

PhD students:

Akanksha Roberts (Since Feb 2019)
Subhasis Mahiri (Since August 2019)
Sagar Narlawar Shrikrishna (Since August 2019)

Sarthak Nandi (Till August 2019)

Project Personnel/ Trainee:
Deepshikha Shahdeo
Samaraggi Choudhury (Since November 2019)
Naina Abbineni, Project Trainee (Since Jan 2020)
Ayusi Mondal (Till August 2019)

Collaborators

Dr Arindam Ghosh	IISc, Bangalore
Dr Ashok Kumar	CSIR -IGIB, Delhi
Prof. Rajakumar Errappa	IIT Hyderabad
Dr Anuj Tripathi	BARC, Mumbai
Prof Sergei E. Eremin	Moscow State University, Russia
Dr Vivek K Bajpai	Inha University, Incheon, Republic of Korea
Dr Shruti Shukla	NIFTEM, Sonipat

Our lab work is focused on to miniaturization of the devices for the efficient detection of bacterial, viral, pesticides, and toxins in livestock and poultry diseases. To execute this work, we are developing robust assays using novel biomaterials and biomolecules. Another area of research is on to develop therapeutic nanovehicle for targeted delivery.

Objective

a. Development of a Sensor for Rapid Detection of Japanese Encephalitis Virus
b. Fabrication of microfluidic device for Aflatoxin detection in milk samples with specific aptamers
c. Disposable Graphene Microfluidic Biosensor for Salmonellosis Detection
d. Detection of endosulfan pesticide for improvement of human and animal health using biosensor coupled with graphite electrode
e. Iron oxide nanoparticles-peptide complexes for imaging of urokinase plasminogen activator receptor (uPAR) in cancer diagnostics
f. Development of peptide functionalized gold nanoparticles for efficient targeting and imaging of urokinase plasminogen activator receptor (uPAR) in cancer diagnostics

Work Reported in 2018-2019- Not Applicable (Joined on 13th July 2018)

Progress of work during the current reporting year (2019-2020)

We propose the following projects related to livestock as per the SAC recommendation. Currently the work

is undergoing for each proposal. The proposal e is in the final stage of its completion.

a. Development of a Sensor for Rapid Detection of Japanese Encephalitis Virus

Zoonotic infections that are transmissible either directly or indirectly between animals and humans are on the increase and pose significant additional threats to human health and the current pandemic status of Japanese encephalitis (JE) is an example of the challenge presented by zoonotic viruses. JE transmits from animals to humans through the bite of an infected mosquito such as Culextritaeniorhynchus and Culex gelid. JE is a brain inflammation that can cause severe headache, confusion, high fever, seizures, disorientation, tremors and death in some cases. Most common diagnosis of JEV infection is performed using JEV–specific IgM ELISA on cerebrospinal fluid or serum. Portable diagnostic system that can provide point-of-care, rapid, sensitive detection of JEV is highly desirable in such settings. Therefore, with this aim in mind, we propose to develop for the first time a microfluidic device for naked eye as well for FET based detection for JEV.

b. Fabrication of microfluidic device for Aflatoxin detection in milk samples with specific aptamers

Mycotoxins are secondary metabolites produced by filamentous fungi belong to the genera Aspergillus and Penicillium. Mycotoxins also found in animal derived foods such as milk due to intake of contaminated feed.

Considering agricultural and economical aspects and possible implications on public health, the most relevant mycotoxins are aflatoxins, ochratoxins, fuminosins, T-2 toxin, zearalenone (ZEA).Aflatoxins pose huge economic burden causing around 25% or more of the world food crops to be destroyed every year. Afl M1 (4-hydroxy aflatoxin B1) and M2 (4-dihydroxy aflatoxin B1) have well established carcinogenic and mutagenic potentiality and pose severe health impacts on milk consumers including the risk of cancer and stunting in children below the age of 5 years.When B1 is ingested by cow, it is secreted as hydroxylated metabolite aflatoxin M1 (Afl M1) in the urine and milk of the cow. Consumption of food containing aflatoxin concentrations of one milligram/kilogram or higher has been suspected to cause aflatoxicosis, the prognosis of which consists of acute liver failure, jaundice, lethargy and nausea, eventually leading to death in 1 to 2 weeks, based on past out breaks. Thus there is a need to develop rapid low cost low technology, highly specific methods for aflatoxins to improve surveillance and control in rural areas.

To meet this requirement recently, aptamer (as biorecognition element) based detection is in increasing demand, due to its higher specificity compared to antibodies, and ease of production in case of antibodies to limit the cross reactivity Microfluidic devices gaining importance as cheap, mass producing, ecofriendly, can be used as alternative technology for on-site detection of Afl B1 and M1.

c. Disposable Graphene Microfluidic Biosensor for Salmonellosis Detection

Avian Salmonellosis is one of the serious disease causing impediments to the poultry industries especially in the developing countries. Salmonellosis is caused by Salmonella species which is a rod-shaped, gram negative bacterium from Enterobacteriaceae family. Salmonella enterica subsp. serover gallinarum is a non- motile bacteria responsible for the disease Fowl typhoid which is a severe systemic disease in poultry organisms causing high mortality.

The present investigation was undertaken with an objective to develop and characterize, biosensors for easy and efficient detection of Fowl typhoid. The biosensor will help in detection of the bacteria using antigen-antibody interaction method. The expected outcome of the said proposed work shall aim at tailored biosensor primarily for the lab-based use for early, cost-effective, diagnosis of Fowl disease. This will help in large scale reduction of mortality rates of the poultry birds by the above mentioned disease which will lead to low economic loss of the poultry farmers and will also increase the production of poultry eggs and ultimately increase the global economy.

d. Detection of endosulfan pesticide for improvement of human and animal health using biosensor coupled with graphite electrode

Endosulfan is a chlorinated insecticide, similar to DDT, which was banned many years ago. Endosulfan builds up in the environment and in the bodies of people, animals, meat and wildlife, and it is transported around the world to remote places. Endosulfan poses unacceptable risks to farm workers

and wildlife, which include neurotoxicity, late sexual maturity, physical deformities, poisoning, among others. A crucial issue regarding food contamination is by pesticides, which are nowadays an integral part of agriculture that poses several reproductive and developmental issues on animal as well human health. Feed and fodder offered to animals are often contaminated with pesticide residues and after feeding, these residues pass into the animal products.

e. Iron oxide nanoparticles-peptide complexes for imaging of urokinase plasminogen activator receptor (uPAR) in cancer diagnostics

Interaction between GFD domain of uPA and SMB domain of Vn with uPAR have been shown by biochemical interaction and loss of function analysis, while on other side importance of targeting uPAR by GFD peptide/IONPs complex has been investigated.

Yet, despite recent evidence of targeting uPAR by GFD peptide for cancer imaging and treatment, we still do not know how SMB peptide contributes in targeting uPAR, when present together with GFD so allosteric effect of GFD and SMB peptide/IONPs complex for targeting and imaging of uPAR mediated cancer need to be addressed.

f. Development of peptide functionalized gold nanoparticles for efficient targeting and imaging of urokinase plasminogen activator receptor (uPAR) in cancer diagnostics

Targeting urokinase plasminogen activator receptor (uPAR) with the use of its short peptides as a ligand urokinase plasminogen activator (uPA) is attracting and growing interest for cancer imaging and treatment. uPAR is overexpressed on a variety of cancer cells, such as those of the prostate, breast, pancreas and lungs. The interaction of uPAR mainly involved the use of two specific ligands uPA and Vitronectin (Vn). Essentially these discoveries have demonstrated that only two ligands (uPA and Vn) may be sufficient to explain all the pleiotropic effects of the receptor. Interaction between growth factor-like domain (GFD) of uPA and Somatomedin B domain (SMB) domain of Vn with uPAR have been thoroughly investigated both structurally and functionally. Importantly, allosteric effect of GFD and SMB was recently discovered that provide a promising novel drug targets for the treatment of cancer.

Future Plans

1. Purification of recombinant protein and generation of polyclonal/monoclonal antibodies in JEV.
2. Development of polyclonal/monoclonal antibodies against antigen in Salmonellosis.
3. Immunization, antibody production, purification, and its characterization for endosulfan.
4. Functionalization and characterization of IONPs, labelling with peptide and fluorescent dye for imaging in DBT-BioCARe project.
5. Compilation of SERB-ECR project, submission of progress report, UC, SE, preparation and submission of manuscripts.

Publications

1. Chandra S, Alam T, Dey J, Baby Chakrapani P S, Srivastava AK, **Gandhi S,** Tripathi PP, Healthy gut, healthy brain: The gut microbiome in neurodegenerative disorders. Curr Top Med Chem. (2020) 20 (13):1142-1153.
2. Bajpai VK, Oh CW, Khan I, Haldorai Y, **Gandhi S,** Lee H, Song X, Kim M, Upadhyay A, Huh YS, Han YK, Shukla S, Fluorescent immunoliposomalnano vesicles for rapid multi-well immuno-biosensing of histamine in fish samples. Chemosp. 2019; 243: 125404.
3. Roberts A, Tripathi PP, **Gandhi S**, Graphene nanosheets as electric mediator for ultrafast sensing of urokinase plasminogen activator receptor - a biomarker of cancer. Biosens Bioelectron. 2019; 141:111398-111404.
4. Dey J, Alam T, Chandra S, **Gandhi S**, Tripathi PP, Recalibrating the Existence of New Neurons in Adult Brain. ACS Chem Neuro. 2019; 10: 2091-2093.
5. Shrivastava M, Srivastava A, **Gandhi S,** Roychoudhury A, Kumar A, Singhal RK, Jha SK, Singh SD, Monitoring of engineered nanoparticles in soil-plant system: A review. Environ Nanotechnol Monit & Manag. 2019; 11:100218-100234.
6. Islam S, Shukla S, Bajpai VK, Han Y-K, Huh YS, Ghosh A, **Gandhi S.** A smart nanosensor for the detection of human immunodeficiency virus and associated cardiovascular and arthritis diseases using functionalized graphene-based transistors. Biosens Bioelectron. 2019; 126: 792-799.

7. Islam S, Shukla S, Bajpai VK, Han Y-K, Huh YS, Ghosh A, **Gandhi S**. Microfluidic based graphene field effect transistor for femtomolar detection of chlorpyrifos pesticide. Sci Reports. 2019; 9: 276-282.
8. **Gandhi S**, Gupta J, Tripathi PP. The Curious Case of Human Hippocampal Neurogenesis. ACS Chem Neuro. 2019; 10, 1131-1132.

Patents

1. Kasoju Aruna, **Sonu Gandhi**. A microfluidic graphene vapour sensor as a device to detect Aflatoxins. TEMP/E-1/24675/2019-CHE, **National filing date 13th June 2019.**
2. Kasoju Aruna, **Sonu Gandhi**. Smart Phone based colorimetric biosensor for the detection of aflatoxin B1 using microfluidic paper device. **Patent application number 201941047443, National filing date 21st November 2019**.

The Lab Photo

Left to Right: Subhasis Mahiri, Samaraggi Choudhury, Sagar Narlawar Shrikrishna, Sonu Gandhi, Akanksha Roberts, Naina Abbineni, Deepshikha Shahdeo

Title: Molecular Genetics for Animal Disease Resistance and Welfare

Sandeep Kushwaha

(Joined on 31st October 2019

Principal Investigator: **Dr. Sandeep Kushwaha**

Project Trainees:

Veerbhan kesarwani (Since Jan 2020)

Collaborators:

Dr. Ravi Gandham	NIAB, Hyderabad
Dr. Sonu Gandhi	NIAB, Hyderabad
Dr. Shailesh Sharma	NIAB, Hyderabad
Dr. Ganesh Kondabattula	DFMD, India
Dr. Katarina Hedlund	Lund University, Sweden

Theme and Objectives of Research

Our lab is focused on molecular genetics to develop methods and tools for animal disease resistance and welfare. Our primary objectives are (a) to develop biological and computational resources to support livestock research in India (b) to develop method to evaluate general disease resistance, environmental adaptation, and climate change effects on animals to support livestock breeding and production systems.

Work Reported in 2019-2020 (Proposed research for funding application)

A. Comparative genomics to identify molecular genetics factors of Malnad gidda breed for FMD resistance

Foot-and-mouth disease (FMD) is a highly contagious viral disease among livestock animals which is causing huge economic losses in livestock production. Moreover, a huge amount of money is required for disease prevention and control every year. FMD has wide range of infection among livestock animals and infect all kind of breeds of cattle except Malnad gigda, a native breed of Karnataka, India. Various kind of researches have been done to understand molecular mechanism of FMD pathogenesis, progress, and FMD vaccine performance and protection. Yet, FMD infection, and short term resistance by vaccine are still poorly understood due to limited scope of conventional methods and resources. So far, no study have been reported to reveal molecular genetics factors for FMD resistance in breed Malnad gidda. In this proposal, we are trying to detect both known and novel molecular factors and variants associated with FMD resistance in breed Malnad gigda by using in silico and wetlab techniques. Specific objectives of proposal is exploration of Genomic landscape of disease resistant and susceptible animal against FMD disease.

B. NGS-based targeted genomics to reveal functional diversity of pathogens involved in bovine mastitis pathogenesis

Bovine mastitis is one of oldest known disease in cattle which is responsible for major revenue losses of dairy industry. Bovine mastitis aetiology is associated with more than 150 different microorganisms, and lot of research have been done on various aspects of disease. yet the influence of pathogen functional diversity on bovine mastitis is poorly understood due to limitation of conventional detection methods such as a) methods are not designed to discriminate isolates of a given bacterial species at large scale,

b) polymerase chain reaction methods have high sensitivity but unable to discover novel species/ strain, and c) unavailability of genomic resources for several important classes of pathogens. So far, none of the research study were reported to reveal the functional diversity of pathogens involved in bovine mastitis pathogenesis at large scale. Larger-scale targeted studies are required to understand multifactorial nature of disease for effective antibiotic treatment; whether particular bacterial species/strain/substrains of pathogen are associated with disease or not. In this project, we are trying to develop pan genome of bovine mastitis associated pathogens to discover new species/strains, and known and novel molecular factors of species and strains by using in silico and wetlab method and techniques.

Progress of the work during the current reporting year (2019-2020)

I am actively engaged to translate concept notes into proposals for extra mural funding

Future Plans

- Submission of proposal for funding
- Execution of pilot studies for proposed research studies

International MOU and Research Funding

- MOU between Swedish University of Agricultural Sciences and NIAB (In progress)
- FCRA clearance to bring research funding from Sweden to India (In progress)

NIAB New Facilities

Large Animal Farm (LAF), NIAB

National Institute of Animal Biotechnology has established a Large Animal Farm on 23 acres of land which was inaugurated on 23rd of December 2019 by Dr. Manju Sharma, Ex- Secretary DBT. The facility has been established with the objective of catering all scientific and academic endeavours of the institute. LAF will suffice all necessary experimental requirements of the institute such as blood, milk and urine samples. The facility has received CPCSEA certification in April 2019 for in-house breeding and maintenance of experimental animals. LAF will adhere and operate as per Central and Institutional (CPCSEA and IAEC) guideline of workflow and operations. At present LAF has in total four shed for Cattle, Buffalo, Sheep and Goat with capacity to harbour 40 each (cattle and Buffalo) and 200 each (Goats and Sheep). An operation theatre has also been established in the LAF to carry out minimal or semi invasive surgeries in experimental animals.

NIAB LAF has Osmanabadi breed of goats. This true to breed goats are found in the breeding tract of the breed i.e. Osmanabad, Maharashtra. The animals are getting acclimatised to the climate and conditions of our LAF and will be ready to be utilised for various research purposes. The animals are tagged and

records pertaining to their feeding and medication are being maintained properly. Serum, milk and blood samples of these goats have also been provided to scientist of NIAB for screening against common and potent animal diseases like *Brucella, Leptospira* and *T. Gondii* etc.

We also have Dangi breed of cattle in our Large Animal Farm. Out of the 10 cattle, 9 are heifers (female animal that has never had a calf) and 1 cattle is in 2nd lactation. The animals are being taken good care off. Their feeding and other management has been on time and they seem to be adjusting to the temperature, climate and ambience of LAF pretty well. Blood and serum samples of the farm animals are being periodically checked for common diseases of animals.

Feed and fodder production has also been initiated in adjacent areas of Cattle and Buffalo farm. The process of soil bed preparation has begun to make the soil suitable for cultivation of essential fodder for animal feeding.

LABORATORY ANIMAL FACILITY, NIAB, HYDERABAD

Dr Jayant P. Hole, Veterinarian (In charge Animal House Facility)

Basic Information

The state-of-the-art barrier-maintained laboratory animal facility at National Institute of Animal Biotechnology is established to conduct experiments using rodents and lagomorphs. It is with clean and dirty (service corridor concept and built in compliance with the guidelines of Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA). The total area spread over two floor approx. 975 Square meter. The experiments conducted on animals at this facility are through the approval of Institutional Animal Ethics committee (IAEC). Russell and Burch's concept of application of 3R Reduction, Refinement and Replacement in all experiments on animals are closely observed. All the utilities viz. chillers, AHU, compressor, soft water plant and electrical control panel for heavy equipment are planned on terrace area with the ease of maintenance personnel movement without entering inside the facility

Objectives and Key features

The facility is a core scientific service department of the Institute with an objective to breed, supply and procure, raise experimental laboratory animals of high quality and sterile conditions. It is focused to provide husbandry, enrichment, nutrition, veterinary care, technical and professional support to the scientific community of the Institute to facilitate research on animals. Defined barrier practices are followed strictly.

The facility is under electronic surveillance (CCTV system). Access to facility is through access cards only for those who are authorized persons it helps to minimize the risk of infection to the animal's colonies. All the parameters like temperature humidity, air velocity pressure and running of AHU are monitored and controlled through BMS (Building monitoring system). Dark and light cycle 12:12 hours for the normal physiological behaviour of the animals is maintained through automated DALI (Digitally accessible lighting interface) control system. Suitable nutrition with appropriate nutrients, water quality and sterilization using high pressure high vacuum autoclaves are used on routine basis to maintain sterile conditions in animal colonies.

This facility is operational from August 2019 and conducting IAEC approved protocols for the experiments on animals. Presently this facility housed inbred strains Balb/c, C57/BL6, CBA/J, FVB, NOD SCID, Neo R Tg line, outbred CD1 and Wistar Rats and Rabbits. All records are properly maintained related to breeding and experiments using registers and software tools. The facility is registered with Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), Ministry of Environment, Forests and climate change, Government of IndiaRegistrationN.2063/GO/RBi/SL/19/CPCSEA dated 10.04.2019.

Patents & Publications (01/04/2019 to 31/03/2020)

Patents

1. **Pankaj Suman,** T Yathirajarao, Pankaj Kumar. "A method for detection of subclinical and clinical mastitis and assessment of microbial quality of milk using non-functionalized iron oxide nanoparticles; **Indian Patent application number- 201941044822; Date of filing: November 5, 2019.**

2. **Girish K Radhakrishnan.** "Immunodominant protein and peptide-based brucellosis diagnosis kits and devices to differentiate infected animals from Brucella abortus S19-vaccinated animals" **Indian patent application number: 201941010993 ; Date of filing: March 20, 2020.**

3. Kasoju Aruna, **Sonu Gandhi.** A microfluidic graphene vapour sensor as a device to detect Aflatoxins. TEMP/E-1/24675/2019-CHE, **National filing date 13th June 2019**.

4. Kasoju Aruna, **Sonu Gandhi.** Smart Phone based colorimetric biosensor for the detection of aflatoxin B1 using microfluidic paper device. **Patent application number 201941047443, National filing date 21st November 2019.**

Publications

1. Bhattacharya I, Sen Sharma S, **Majumdar SS**. Pubertal orchestration of hormones and testis in primates. Mol Reprod Dev. 2019; 86(11):1505-1530.
2. Wei He, **H.B.D.Prasada Rao**, Shangming Tang, Nikhil Bhagwat, Dhananjaya Kulkarni, Yunmei Ma, MariaA.W. Chang, Christie Hall, Junxi Wang, HarrisonS. Manacsa, Christ a Baker, GerrikF. Verhees, Lepakshi Singh, Xiangyu Chen, NancyM. Hollingsworth, Pe tr Cejka, Neil Hunter; Regulated Proteolysis of MutSγ Controls Meiotic Crossing Over. Mol.cell, 2020 ;78(1):168-183
3. M Jacquot, PP Rao, S Yadav, K Nomikou, S Maan, YK Jyothi, N Reddy, K Putty, D Hemadri, KP Singh, NS Maan, **NR Hegde**, P Mertens, R Biek. Contrasting selective patterns across the segmented genome of bluetongue virus in a global reassortment hotspot. *Virus Evolution 5(2):vez027.*
4. P Sheela, S Isloor, D Rathnamma, BM Veeregowda, BE Shambulingappa, ML Satyanarayana, S Sundareshan, **NR Hegde.** 2019. Characterization by spa typing of Staphylococcus aureus isolates originating from bovine and bubaline mastitis in southern India. *Indian J Comp Microbiol Immunol Infect Dis 40(1):21-30.*
5. Baig MS, Anjali Roy, Rajpoot S, Dongfang Liu, **Faisal SM** Saluja R, Saqib U, Ohishi T, Wary KK. Tumour-derived exosomes in the regulation of macrophage polarization. Inflamm Res. **2020**, 69, (5) 435–451.
6. Vennila KN, Prabha K, Deval S**, Subbiah M,** Elango KP. Preparation and biological evaluation of quinoline amines as anti-cancer agents and its molecular docking. *Medicinal Chemistry Research* 28, 1298–1307 (2019).
7. G. Mahalakshmi, K. N. Vennila, B. Selvakumar, P. Lakshmana Rao, Ruchi Malwade, Sunny Deval, **S. Madhuri,** M. Seenivasaperumal & Kuppanagounder P. Elango. Spectroscopic investigations on DNA binding profile of two new naphthyridinecarboxamides and their application as turn-onfluorescent DNA staining probes. *Journal of Biomolecular Structure and Dynamics* 28, 1-9 (2019).
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9. Roy S, Bhandari V, Dandasena D, Murthy S, **Sharma P.** Genetic Profiling Reveals High Allelic Diversity, Heterozygosity and Antigenic Diversity in the Clinical Isolates of the Theileria annulata From India.Front Physiol. 2019; 10:673.
10. Vandna B, Anita G, **Paresh S.** Haematological alterations and molecular detection of theileriosis in crossbred cattle. Indian Journal of Animal Sciences 2019; 89(6): 615–618.
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14. Kundave V R, Ram H, Shahzad, M, Garg R, Banerjee P S, Nehra A K, Rafiqi S I, **Ravi kumar G,** Tiwari A K. Genetic characterization of Theileria species infecting bovines in India. Infect Genet Evol 2019; 75:103962.
15. Manjunath S, Saxena S, Mishra B, Santra L, Sahu A R, Wani S A, Tiwari A K, Mishra B.P, Singh R K, Janga SC, **Kumar G R.** Early transcriptome profile of goat peripheral blood mononuclear cells (PBMCs) infected with peste des petits ruminant's vaccine virus (Sungri/96) revealed induction of antiviral response in an interferon independent manner. Res Vet Sci 2019; 124:166-77.
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18. Chandra S, Alam T, Dey J, Baby Chakrapani P S, Srivastava AK, **Gandhi S,** Tripathi PP, Healthy gut, healthy brain: The gut microbiome in neurodegenerative disorders. Curr Top Med Chem. 2020; 20(13):1142-1153.
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23. Islam S, Shukla S, Bajpai VK, Han Y-K, Huh YS, Ghosh A, **Gandhi S.** A smart nanosensor for the detection of human immunodeficiency virus and associated cardiovascular and arthritis diseases using functionalized graphene-based transistors. Biosens Bioelectron. 2019; 126: 792-799.
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MoUs

The details of MoU signed during the period from 1 April 2019 to 31 March 2020 by NIAB are given below:

Sl. No.	MoU with	Date of Signing
(i)	International Livestock Research Institute (ILRI), Nairobi, Kenya	20th August 2019
(ii)	University of Hyderabad for BSL-3 facility	27th February 2020

DEPUTATIONS ABROAD OF NIAB PERSONNEL from 01 April 2019 to 31 March 2020

Name and Designation	Journey Period	Country of Visit and purpose	Funded by
Dr.Nagendra R. Hegde, Scientist-G	07/04/2019 to 15/04/2019	UK - To attend meetings and training for collaborative project on poultry AMR at University of Liverpool from 08/04/2019 to 12/04/2019	Organizers & extra mural funded project
Dr. G.V.P.P.S. Ravi Kumar, Scientist-G	13/04/2019 to 17/05/2019	USA - To visit Animal Genomics and Improvement Laboratory for training to learn the entire bioinformatics pipeline for mining the whole genome sequences to filter out informative SNPs at Animal Genomics and Improvement Laboraotory, BARC-East, Beltsville from 15/04/2019 to 15/05/2019	Livestock Genomics Project
Dr. Madhuri Subbiah, Scientist-D	30/04/2019 to 05/05/2019	UK - To attend BBSRC-IP Collaborator's meeting at University of Liverpool and to meet Prof. V. Nair at Pirbright Institute from 01/05/2019 to 03/05/2019	Organizers (Liverpool, UK)
Dr. Subeer S. Majumdar, Director	19/08/2019 to 23/08/2019	Kenya – To sign MoU with ILRI, Nairobi	NIAB Core Funds
Dr. Paresh Sharma, Scientist-D	16/07/2019 to 15/09/2019	USA - To attend Collaborative project training at Cornell University, New York from 16/07/2019 to 15/09/2019	Organizers (Cornell University, USA)
Dr. Bappaditya Dey, Scientist-E	08/12/2019 to 13/12/2019	UK – To attend project related meeting and to attend workshop at University of Reading from 08/12/2019 to 12/12/2019	Organizers (University of Reading,UK)
Dr. Paresh Sharma, Scientist-D	08/12/2019 to 13/12/2019	UK – To attend project related meeting and to attend workshop at University of Reading from 08/12/2019 to 12/12/2019	Organizers (University of Reading,UK)
Dr. Subeer S. Majumdar, Director	22/02/2020 to 28/02/2020	London - To visit Roslin Institute, BBSRC & University of Nottingham for discussing about joint development of research programs in Livestock Sciences from 23/02/2020 to 26/02/2020	NIAB Core Funds

DISTINGUISHED VISITORS AND LECTURES

Inauguration of Large Animal Facility on 23rd Dec 2019

The Large Animal Facility (LAF) of the Institute was inaugurated by Dr. Manju Sharma, Former Secretary, Department of Biotechnology in the presence of Dr G. Padmanaban, Former Director, Indian Institute of Science (IISc) and Dr V.P Kamboj, Former Director, Central Drug Research Institute (CDRI) on 23rd December 2019

Sl. No.	Visitor	Title of Lecture	DATE
01	Dr. Surajit Sengupta, Dean, TIFR Hyderabad	"Identifying Collective Displacements in Apo-proteins that Reveal Eventual Binding Pathways"	17-05-2019
02	Prof. Bruce Whitelaw, Chairman Edinburgh Genomics & Chairman of the Roslin Innovation Center at University of Edinburgh, U.K	"Engineering Disease Resistance in Livestock	05-08-2019
03	Prof. GP Talwar, Director Research, Talwar Research Foundation, Delhi	"Walking through the Memory Lane"	10-08-2019
04	Dr. Paul Rasmussen	NanoString technology and its application in translational research	27-09-2019
05	Dr. Renu Swarup, Secretary, DBT	--	10-10-2019
06	Dr. Pawan Kumar, University of California	Watching '3R's of life' at the single-molecule level"	14-10-2019
07	Prof D. Balasubramanian, Director Emeritus, LVPEI, Hyderabad	"How did India become the global supplier of medicines and vaccines?"	23-10-2019
08	Dr. Mike McGrew, Roslin Institute, UK	"Using genome editing in chicken for investigating adaptation traits and bio-banking of rare chicken breeds disease resistance"	13-11-2019
09	Shri C.P Goyal, Joint Secretary (Admin), DBT	--	18-11-2019
10	Dr. Manju Sharma, Former Secretary, DBT	--	23-12-2019
11	Prof. G Padmanaban	"My Journey with Biotech and Translation Industry"	23-12-2019
12	Dr. Renukaradhya J. Gourapura, Professor of Veterinary Preventive Medicine, Food Animal Health Research Program at The Ohio State University, USA	"Innovative mucosal vaccine delivery methods to augment cross-protective immunity: pig a biomedical model"	37-12-2019

Visit of Dr Renu Swarup, Secretary, DBT on 10th October 2019

Visit of Shri C.P Goyal, Joint Secretary, DBT, New Delhi on 18th Nov. 2019

Celebration of Foundation Day-2019

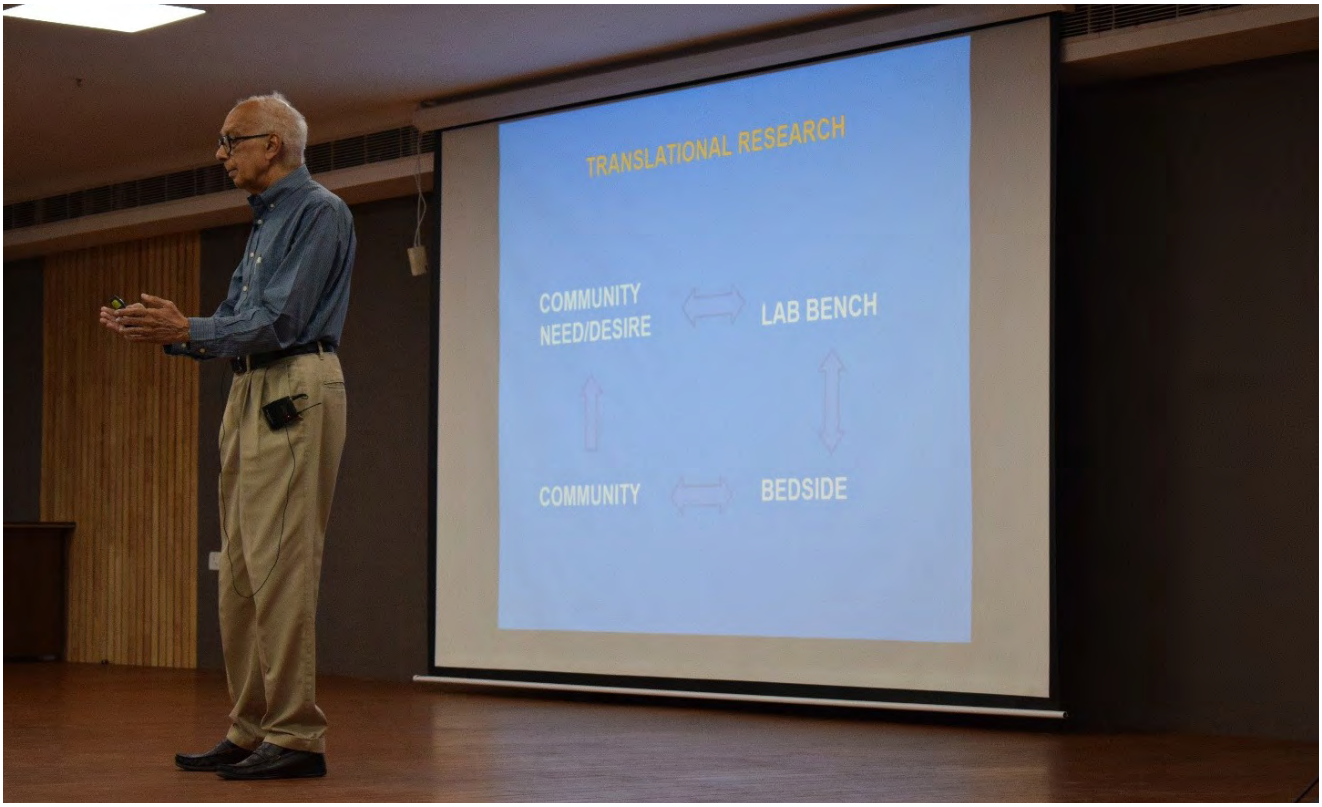
Foundation day lecture by Dr G.P Talwar

Visit of Dr Bruce Whitelaw, Roslin Institute, U.K

Distinguished lecture by Dr Bruce Whitelaw, Roslin Institute, U.K on 5th August 2019

Distinguished lecture by Dr G. Padmanaban, on 23rd Dec.2019

GRC lecture by Prof. Appa Rao Podile on 9th August 2019 at NIAB auditorium



Distinguished lecture by Prof D. Balasubramanian on 23rd Oct. 2019

Dr. Surajit Sengupta, Dean, TIFR Hyderabad delivered GRC lecture on 17th May 2019

Distinguished lecture by Dr Mike Mcgrew, Roslin Institute on 4th July 2019

Linkage meeting on DBT flagship programme entitled "Genomic associated pathobiology to identify novel targets for therapeutic invention against Japanese Encephalitis and Leptospirosis"

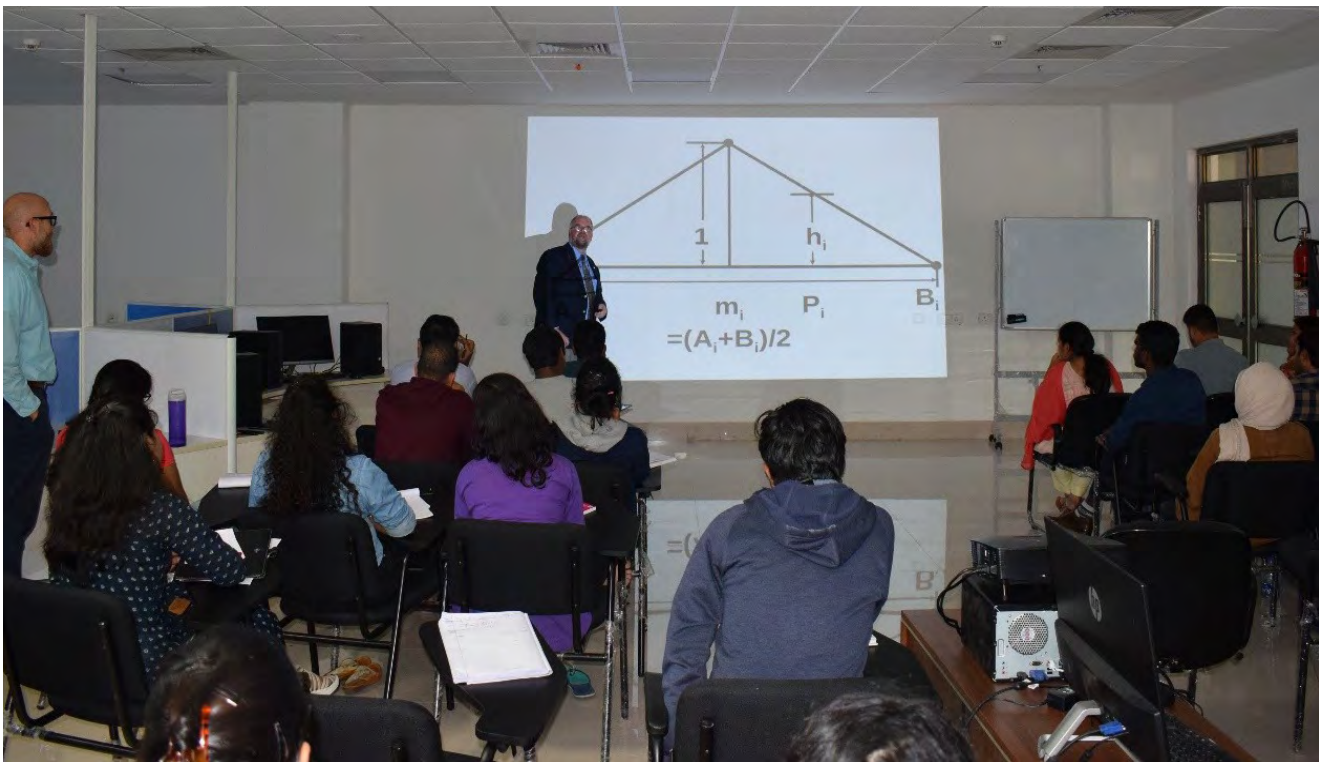
Brainstorming and Training on "Livestock Genomics for Conservation of Indigenous Cattle"

Welcome address by Dr Subeer S Majumdar , Director, NIAB

Dr A.K Rawat, Advisor, DBT, New Delhi

Brainstorming and Training on "Livestock Genomics for Conservation of Indigenous Cattle"

Delegates in front of NIAB



Training session by Dr Curt Van Tassell

NIAB Outreach Activities

Bridge Programme

Bridge programme was initiated in order to connect, NIAB scientists with national educational needs of schools and colleges. The aim is to generate excitement towards science in young minds. Lectures and practicals are conducted in various higher secondary schools. In addition, school and college students frequently visit NIAB so as to have an exposure of research scenario in biotechnology. During 2019-20, total 94 lectures were delivered by NIAB scientists at various schools in Hyderabad. Also open days were observed for school and college students.

Appellate Authority : Dr Syed Faisal
Central Public Information Officer : Shri P.S.G.S Pavan Kumar
Details about the RTI applications and appeals received in NIAB

As received under RTI Act 2005	Opening Balance as on 01.04.2019	Received during the year 2019-20			Disposed of during the year 2019-20				
		Received directly	Received as transfer from other Public Authorities [u/s 6(3) of Act]	Total	Decisions where applications accepted/ appeals upheld	Decisions where applications/ appeals rejected	Transferred to other Public Authorities [u/s 6(3) of Act]	Total	Closing Balance as on 31-03-2020
Applications	0	4	19	23	23	0	0	23	0
Appeals	0	01	Not applicable	01	01	0	Not applicable	01	0

IMPORTANT EVENTS

Sl. No.	Events	Date
1.	Dr. Subeer S. Majumdar delivered inaugural talk on "Overcoming challenges for moving upwards in scientific pursuit under Indian scenario; a story about art of science" to initiate Gachibowli Research Cluster (GRC) series, at School of Life Science, University of Hyderabad.	05.04.2019
2.	First meeting of Institutional Animal Ethics Committee of NIAB	10.05.2019
3.	Celebration of National Technology Day	11.05.2019
4.	Celebration of Swachhta Pakhwada 2019	01-05.2019-15.05.2019
5.	Dr. Surajit Sengupta, Dean, TIFR Hyderabad delivered Gachibowli Research Cluster (GRC; including UOH, TIFR, NIAB, IIIT)-lecture on his work on "Identifying Collective Displacements in Apo-proteins that Reveal Eventual Binding Pathways" at NIAB auditorium.	17.05.2019
6.	An "Interaction Meeting with State Officials, Farming Community and Experts at Yadgir - an Aspirational district in Karnataka" was organized by NIAB scientists and DBT officials at Yadgir, Karnataka	20.06.2019-21.06.2019
7.	Celebration of 5th International Day of Yoga (IDY).	21.06.2019
8.	Dr. Nirmalya Ganguli Scientist C, NIAB conducted FACS training for NIAB internal students.	15.07.2019-16.07.2019
9.	A linkage meeting on DBT flagship programme entitled "Genomic associated pathobiology to identify novel targets for therapeutic invention against Japanese Encephalitis and Leptospirosis" was organized at NIAB inviting experts from different parts of country for formulating the strategy for execution of the project.	26.07.2019-27.07.2019
10.	A one-day interactive and training meeting on "Guidelines to good practices in housing and working with laboratory animals" was organized at NIAB. External experts provided training and useful tips to both students and scientists for working in new animal facility of NIAB.	27.07.2019
11.	Dr. Nagendra Hegde organized and attended a week-long summer school training in social science research methodologies. This was part of our India-UK collaborative project on understanding drivers of antimicrobial resistance (AMR) and designing strategies to rationally use antimicrobials in poultry meat production in India. The training also included personnel from two other projects funded through the same call to address AMR in India as well as another project looking at food chain and food security. The training was conduced in association with National Dairy Research Institute - South Regional Station, at NDRI, Bangalore	29.07.2019-02.08.2019
12.	19 newly jointed scientists (Sci-C) of DBT visited NIAB as a part of their orientation programme to familiarize them with the administrative, HR procedures and to interact with NIAB scientists.	05.08.2019

13.	DBT's Sub-Committee meeting to review Animal Biotechnology Programme of the Department for 15th Finance Commission was held.	05.08.2019
14.	Distinguished lecture delivered by Prof. Bruce Whitelaw, Chairman Edinburgh Genomics, Chairman of the Roslin Innovation Center at University of Edinburgh, United Kingdom on "Engineering Disease Resistance in Livestock"	05.08.2019
15.	Director, NIAB participated and delivered a talk entitled "Attempts to modify techniques for affordable gene editing in livestock." in the scientific session during International workshop of Livestock Gene Editing which was conducted in collaboration with Washington State University, Pullman, USA at Madras Veterinary College, Chennai.	07.08.2019
16.	First Foundation Day lecture was delivered by Prof. GP Talwar, Director Research, Talwar Research Foundation, Delhi on "Walking through the Memory Lane"	10.08.2019
17.	NIAB's first Annual Day was celebrated on 11th August 2019	11.08.2019
18.	73rd Independence Day was celebrated on 15th August 2019 by hoisting the national flag at NIAB and by conducting games for the children.	15.08.2019
19.	Pledge for Sadbhavana Diwas was taken on 20th August 2019	20.08.2019
20.	Director, NIAB delivered an invited lecture as an esteemed speaker on "How Academic Research is driving innovation and growth essential or expense" at the 'The Economic Times L.I.F.E Summit' (Life Sciences Industry Forum for Excellence) at Hyderabad.	23.08.2019
21.	NIAB's 12th Finance Committee meeting was held at Ministry of Earth Sciences, New Delhi	26.08.2019
22.	Hindi Pakhwada	01.09.2019-16.09.2019
23.	Brainstorming and Training on "Livestock Genomics for Conservation of Indigenous Cattle" was organized at NIAB	10.09.2019-11.09.2019
24.	12th Governing Body meeting of NIAB was conducted at DBT, New Delhi.	20.09.2019
25.	6th Internal Complaints Committee meeting held on 24th Sept 2019 at NIAB. Also organised a talk on "Prevention and Prohibition of Sexual Harassment of Women at Workplace" was delivered by Smt. M. Sreelekha (Advocate) as an awareness program.	24.09.2019
26.	On occasion of Swachhta Hi Sewa 2019, Shram-daan was held at NIAB on 27th September, 2019.	27.09.2019
27.	A talk on NanoString technology and its application in translational research was delivered by Dr. Paul Rasmussen at NIAB on 27th September 2019.	27.09.2019
28.	Shram-daan as a part of "Swachhta Hi Sewa-2019" was held on 1st Oct 2019 at 4.30 pm in the NIAB campus.	01.10.2019
29.	NIAB celebrated the "World Animal Day" on 4th October 2019 at NIAB by conducting oral presentations by students/fellows on "How research on animals is equally important as those for humans".	04.10.2019

30.	Secretary, DBT visited NIAB on 10th October 2019	10.10.2019
31.	Dr. Pawan Kumar, from Prof. Stephen Kowalczykowski's lab, University of California Davis delivered a lecture on "Watching '3R's of life' at the single-molecule level" was held on 14th Oct 2019 at 11 am in the NIAB class room.	14.10.2019
32.	Director alongwith few Scientists & Students participated in the Second annual meeting of Animal Physiology Association, held on 14th and 15th Oct 2019 at Tirupati.	14.10.2019-15.10.2019
33.	Delegates from ILRI visited NIAB on 17th October 2019 to identify the priority areas of collaborative research.	17.10.2019
34.	NIAB organized Outreach Programme on 23rd October, 2019 by inviting school, college students and organizing various scientific activities to popularize India International Science Festival (IISF 2019) being organized by DST from 5-8 November, 2019 at Kolkata.	23.10.2019
35.	To mark celebration of 150th Birth anniversary of Mahatma Gandhi, NIAB organized Science Popularization program on 23rd October, 2019 by inviting school, college students and faculties/scientists and organizing various scientific activities.	23.10.2019
36.	Prof D. Balasubramanian, Director Emeritus, LVPEI, Hyderabad delivered a distinguished lecture on "How did India become the global supplier of medicines and vaccines?" at NIAB auditorium on 23rd October 2019.	23.10.2019
37.	Annual General meeting of NIAB held in New Delhi on November 1, 2019.	01.11.2019
38.	Director and faculty of NIAB attended the India international Science Festival Kolkata held from 5th to 8thNovember 2019.	05.11.2019-08.11.2019
39.	Dr. Mike McGrew, Roslin Institute, UK delivered distinguished lecture on "Using genome editing in chicken for investigating adaptation traits and bio-banking of rare chicken breeds disease resistance" on November 13, 2019.	13.11.2019
40.	Joint Secretary, DBT, Shri CP Goyal visited NIAB	18.11.2019
41.	Dr. Meeraji Rao, Senior consultant interventional cardiologist of Continental Hospital delivered a health talk on "Lifestyle and precautions for cardiac health" in the NIAB Auditorium.	20.11.2019
42.	NIAB organized a Road show to popularize Global Bio-India-2019	21.11.2019-23.11.2019
43.	GeM (Government e marketplace) training session was conducted on 4th Dec 2019 by Shri Sheik Nizamuddin, Reginal Manager for Telangana region to all the NIAB staff.	04.12.2019
44.	Prof. G Padmanaban delivered a Distinguished lecture on "My Journey with Biotech and Translation Industry" on 23rd December, 2019 in the NIAB Auditorium.	23.12.2019
45.	Dr. Manju Sharma, Former Secretary, DBT inaugurated NIAB's Large Animal Facility.	23.12.2019

46.	Dr. Renukaradhya J. Gourapura,Professor of Veterinary Preventive Medicine, Food Animal Health Research Program at The Ohio State University, USA delivered distinguished lecture on "Innovative mucosal vaccine delivery methods to augment cross-protective immunity: pig a biomedical model" on December 27, 2019 in the NIAB Auditorium.	27.12.2019
47.	Third Project Monitoring Committee (PMC) meeting to evaluate the progress of the project - "Genomics for Conservation of Indigenous Cattle Breeds and for enhancing milk yield, Phase-I" was held at NIBMG, Kalyani.	11.01.2020
48.	Director, NIAB Visited MAFSU, Nagpur to interact with the scientists & VC of MAFSU, Nagpur about one health /AMR centre at National Institute of Animal Biotechnology, Hyderabad.	04.02.2020
49.	Prof. S. Dayananda, School of Life Sciences, UoH has delivered GRC lecture on "Logic Driven Science-Endless Conclusions: The Race Towards Elucidating the Physiological Role of Bacterial Phosphotriesterases" at NIAB Hyderabad.	14-02-2020
50.	Scientists & Director, NIAB attended the Bio-Asia 2020 at HITEX, Hyderabad.	17-02-2020-19-02-2020
51.	Director, NIAB visited The Roslin Institute, University of Edinburgh, BBSRC, London and University of Nottingham, Nottingham to discuss about joint development of research programs in livestock sciences.	22-02-2020-27-02-2020
52.	Talk by Dr. Nagendra R. Hegde, Scientist G on "Covid-19 : Rumors and Facts" in the NIAB auditorium.	11.03.2020
53.	11th Scientific Advisory Committee meeting of NIAB was held at NIAB, Hyderabad.	14.03.2020
54.	DBT expert group meeting on 'One Health' was held at NIAB, Hyderabad.	15.03.2020

Organisational structure of NIAB

ORGANISATIONAL STRUCTURE OF NIAB

NIAB SOCIETY

Dr. Harsh Vardhan Hon'ble Minister of S&T, GoI	President
Dr. Renu Swarup Secretary, DBT, New Delhi	Member
Shri B. Anand, IAS Additional Secretary & Financial Adviser, DBT, New Delhi	Member
Shri C. P. Goyal Joint Secretory (Admin), DBT, New Delhi	Member
Dr. Trilochan Mohapatra Secretary, DARE, New Delhi	Member
Animal Husbandry Commissioner, GoI, New Delhi	Member
Dr. A. K Rawat Advisor, DBT, New Delhi	Member
Prof. Appa Rao Podile Vice Chancellor, UOH, Hyderabad	Member
Dr. A. K. Srivastava Chairman, ASRB, New Delhi	Member
Dr. Shahid Jameel CEO, the Welcome Trust/DBT India Alliance, Hyderabad	Member
Dr. R. N. K. Bamezai Former VC, SMVDU, J&K	Member
Dr. A.S Nanda VC, GADVASU, Ludhiana	Member
Dr. Anuradha Lohia VC, Presidency University, Kolkota	Member
Dr. V. A. Srinivasan Advisor, NDDB, Hyderabad	Member
Dr. (Ms) Anuradha Acharya Director, Oscimum Bio Solutions, Hyderabad	Member
Dr. D.K Dey CEO, Globion India Pvt Ltd, Hyderabad	Member

Dr. Ravi Kumar Scientist G, NIAB, Hyderabad	Member
Dr. Subeer S. Majumdar Director, NIAB, Hyderabad	Member Secretary

NIAB GOVERNING BODY

Dr. Renu Swarup Secretary, DBT, New Delhi	Chairperson
Shri B. Anand, IAS Additional Secretary & Financial Adviser DBT, New Delhi	Member
Shri C. P. Goyal Joint Secretory (Admin), DBT, New Delhi	Member
Dr. Trilochan Mohapatra Secretary, DARE, New Delhi	Member
Animal Husbandry Commissioner, GoI, New Delhi	Member
Dr. A. K Rawat Advisor, DBT, New Delhi	Member
Prof. Appa Rao Podile Vice Chancellor, UOH, Hyderabad	Member
Dr. A. K. Srivastava Chairman, ASRB, New Delhi	Member
Dr. Shahid Jameel CEO, the Welcome Trust/DBT India Alliance, Hyderabad	Member
Dr. R. N. K. Bamezai Former VC, SMVDU, J&K	Member
Dr. A. S. Nanda VC, GADVASU, Ludhiana	Member
Dr Anuradha Lohia VC, Presidency University, Kolkata	Member
Dr. V. A. Srinivasan Advisor, NDDB, Hyderabad	Member
Dr. (Ms) Anuradha Acharya Direstor, Oscimum Bio Solutions, Hyderabad	Member

Dr. D. K. Dey CEO, Globion India Pvt Ltd, Hyderabad	Member
Dr. Ravi Kumar Scientist G, NIAB, Hyderabad	Member
Dr. Subeer S. Majumdar Director, NIAB, Hyderabad	Member Secretary

NIAB SCIENTIFIC ADVISORY COMMITTEE (SAC)

Dr. K. M. Bujarbaruah Vice Chancellor, AAU, Assam	Chairman
Dr. A. K. Rawat Advisor, DBT, New Delhi	Member
DDG ICAR, New Delhi	Member
Dr. B. P. Mishra Joint Director (Research) IVRI, Bareilly	Member
Prof John Hickey Roslin Institute, U.K	Member
Prof. Avery August CornelL University, USA	Member
Prof. R Medhamurthy IISc. Bangalore	Member
Dr. Shekhar Mande DG, CSIR, New Delhi	Member
Dr. Chandrima Saha Former Director, NII, Delhi	Member
Dr. G. R. Chandak CCMB, Hyderabad	Member
Prof. Dhinakar Raj Director, TRPV, TANUVAS, Chennai	Member
Dr. K. R. Trivedi, Advisor, NDDB, Anand, Gujarat	Member
Dr. Subeer S. Majumdar Director, NIAB, Hyderabad	Member Secretary

NIAB FINANCE COMMITTEE (FC)

Shri B. Anand, IAS Additional Secretary & Financial Adviser DBT, New Delhi	Chairman
Dr. Subeer S. Majumdar Director, NIAB, Hyderabad	Member
Dr. A. K Rawat Advisor, DBT, New Delhi	Member
Dr. A. K. Srivastava Chairman, ASRB, New Delhi	Member
Prof. Appa Rao Podile Vice Chancellor, UoH, Hyderabad	Member
Shri Harjit Singh Senior manager (Admin & Fin), NIAB, Hyderabad	Member
Shri I. Jagadeesh Manager (Office & Finance), NIAB, Hyderabad	Non-Member Secretary

NIAB BUILDING COMMITTEE (BC)

Dr. J. Gowrishankar Director, IISER, Mohali	Chairman
Prof. P. Reddanna Former Director NIAB, Hyderabad	Member
Dr. Subeer S .Majumdar Director, NIAB, Hyderabad	Member
Shri B.L.N. Reddy Superintending Engineer, HMDA, Hyderabad	Member
Shri Rajasekhar Sup Engineer, TIFR, Hyderabad	Member
Shri Harjit Singh Senior manager (Admin & Fin), NIAB, Hyderabad	Member Secretary

COMPLAIN COMMITTEE FOR THE PREVENTION AND PROHIBITION OF SEXUAL HARASSMENT

The following internal complaint committee has been constituted for the prevention and prohibition of sexual harassment in accordance with Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act 2013:

Dr. Madhuri Subbiah, Scientist	- Chairperson
Smt. M. Sreelekha, Legal Expert	- Member
Shri Harjit Singh, Senior Manager	- Member
Shri Santosh Mhadeshwar, Manager S&P	- Member
Ms Dilna S.V., Technical Officer	- Member
Ms Krishna Priya, PA to Director	- Member Secretary

NIAB Staff

NIAB Staff

Scientific Staff

S.No.	NAME	DESIGNATION
1.	Dr. Subeer S Majumdar	Director
2.	Dr. Nagendra R. Hegde	Scientist-G
3.	Dr G.V.P.P.S Ravi Kumar	Scientist-G
4.	Dr. Girish K Radhakrishnan	Scientist-E
5.	Dr. Bappaditya Dey	Scientist-E
6.	Dr. H.B.D Prasada Rao	Scientist-E
7.	Dr. Syed Mohd Faisal	Scientist-E
8.	Dr. Amit Kumar Goyal	Scientist-E (till- 12/06/2019)
9.	Dr. Sandeep Kumar Kushwaha	Scientist-E (w.e.f. 31/10/2019)
10.	Dr. Madhuri Subbiah	Scientist-D
11.	Dr. Anand Srivastava	Scientist-D
12.	Dr. Paresh Sharma	Scientist-D
13.	Dr. Shailesh Sharma	Scientist-D
14.	Dr. Sonu Gandhi	Scientist-D
15.	Dr. Abhijit S Deshmukh	Scientist-C
16.	Dr. Nirmalya Ganguli	Scientist-C
17.	Dr. Pankaj Suman	Scientist-C
18.	Mr. Sarwar Azam	Scientist-C
19.	Dr. Satyapal Arya	Scientist-B (till- 16/12/2019)
20.	Dr. Vasundhra Bhandari	DST Inspire Faculty

Technical Staff

S.No.	NAME	DESIGNATION
1.	G. Rama Devi	Technical Officer
2.	Shashikant Dasharath Gawai	Technical Officer
3.	A. Hari Krishna	Technical Officer
4.	P. Praveen Kumar	Technical Officer
5.	Dilna S. V.	Technical Officer
6.	Kapil Kumar	Technical Officer
7.	Preethi Prasanna	Technical Officer
8.	Nilanjana Ganguli	Technical Officer

Administrative and Support Staff

S.No	NAME	DESIGNATION
1.	Harjit Singh	Senior Manager (Admin & Finance)
2.	I. Jagadeesh	Manager (Office & Finance)
3.	Santosh Namdeo Mhadeshwar	Manager (Stores & Purchase)
4.	Ravindranath Mulla	Sup Engineer
5.	V. Ramesh Babu	Service & Maintenance Engineer
6.	PSGS Pavan Kumar	Asst Manager (Office & Estate)
7.	Prem Kumar Kukumalla	Security Officer
8.	K. Krishna Priya	PA to Director
9.	Bookya Rajendra Prasad	Librarian

Ancillary Staff

1.	Dr. Jayant Pundalik Rao Hole	Animal House i/c
2.	Dr. Himanshu R. Patil	Farm Manager

Picture Gallery

Independence Day Celebration

Visit of newly recruited Scientists of DBT

Global Bio India - 2019

Constitution Day - 2019

Hindi Pakhwada - 2019

Tree plantation drive

Signing of MoU with ILRI

Internal Audit Team visit to NIAB

Report on Swachhta Pakhwada (May 1-15, 2019)

Audit Statement of Accounts 2019-20

CHARY AND CO.
CHARTERED ACCOUNTANTS

M.S. Appala Chary FCA
9441490545
ca.msachary@gmail.com

AUDITOR'S REPORT

The Director
National Institute of Animal Biotechnology (NIAB),
Opp. Journalist Colony, Near Gowlidoddy,
Extended Q City Road, Gachibowli,
Hyderabad - 500 032

Dt:07th July 2020

We have audited the attached Balance Sheet of **NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY**, Hyderabad, as at 31st March 2020 and also the Income & Expenditure Account for the year ended on that date annexed there to. These financial statements are the responsibility of the organization management. Our responsibility is to express an opinion on these financial statements based on our audit.

We report that:

1. We have obtained all the information and explanations, which are to the best of our knowledge and belief, were necessary for the purpose of our audit.
2. In our opinion, the organization has kept proper books of account as required by law so far, as appears from our examination of those books.
3. The Balance sheet and Income & Expenditure account dealt with by this report is in agreement with the books of accounts.
4. The Institute has maintained accounts on Accrual basis.
5. In our opinion and to the best of our information and according to the explanations given to us, the said Balance sheet and the Income & Expenditure account read together with the notes thereon gives the required information in the manner so required and give a true and fair view.
    a) In so far as it relates to the Balance sheet as at 31st March 2020 and
    b) In so far as it relates to the Income & Expenditure account excess of expenditure over income for the year ended on 31st March 2020.

For CHARY AND CO
Chartered Accountants
F R No. 014102S

M S Appala Chary
Chartered Accountant
M. No. 221442
UDIN: 20221442AAAAAQ9247

Place: Hyderabad
Date: 07/07/2020

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY, HYDERABAD

BALANCE SHEET AS ON 31st MARCH 2020

(Amount - Rs.)

Particulars	Schedule	Current Year	Previous Year
CORPUS/CAPITAL FUND AND LIABILITIES			
Corpus / Capital Fund	1	1,857,773,123.74	1,866,087,121.45
Reserves and Surplus	2	-	-
Earmarked / Endowment funds	3	111,417,836.01	132,100,156.04
Secured Loans & Borrowings	4	-	-
Unsecured Loans & Borrowings	5	-	-
Differed Credit Liabilities	6	-	-
Current Liabilities and Provisions	7	29,018,405.15	9,006,414.00
TOTAL		**1,998,209,364.90**	**2,007,193,691.49**
ASSETS			
Fixed Assets	8	1,864,947,670.45	1,673,567,450.37
Investments- From Earmarked / Endowment Funds	9	111,417,836.01	132,100,156.04
Investments - Others	10	13,382,163.99	3,399,843.96
Current Assets, Loans, Advances etc.	11	8,461,694.45	198,126,241.12
Miscellaneous Expenditure		-	-
TOTAL		**1,998,209,364.90**	**2,007,193,691.49**
Significant Accounting Policies	24		
Contingent Liabilities and Notes on Accounts	25		

Dr Subeer S. Majumdar
Direcor
NIAB
Subeer S. Majumdar
Director
National Institute of Animal Biotechnology (NIAB)
(An Autonomous Institute of Department of Biotechnology, MoS&T, GoI)
Survey No.37, Opp:Journalist Colony, Near Gowlidoddi,
Extended Q City Road, Gachibowli, Hyderabad-500 032.

For CHARY AND CO
Chartered Accountants
F R No. 014102S
M S Appala Chary
Chartered Accountant
M. No. 221442
CHARY & CO CHARTERED ACCOUNTANTS FRN : 014102S M.No. 221442

Harjit Singh
Sr. Manager (Admin & Finance)
NIAB
हरजीत सिंह/Harjit Singh
वरिष्ठ प्रबंधक (प्रशासन और वित्त)
Senior Manager (Admin & Finance)
राष्ट्रीय पशु जैव प्रौद्योगिकी संस्थान
National Institute of Animal Biotechnology
हैदराबाद/Hyderabad.

I Jagadeesh
Manager (Office & Finance)
NIAB
आई. जगदीश
प्रबंधक (कार्यालय और वित्त)
Manager (Office & Finance)
राष्ट्रीय पशु जैव प्रौद्योगिकी संस्थान
National Institute of Animal Biotechnology (NIAB)
हैदराबाद/Hyderabad.

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY, HYDERABAD

Income And Expenditure Statement for the year ended on 31st MARCH 2020

(Amount - Rs.)

Particulars	Schedule	Current Year		Previous Year	
INCOME					
Income from Sales/Services	12		4,72,001.00		71,615.00
Grants/Subsides	13		165,800,000.00		110,000,000.00
Fees/Subscriptions	14		-		-
Income from Investments	15		-		-
Income from Royalty, Publications etc.	16		-		-
Interest Earned	17		-		9,446,421.67
Other Income	18		2,898,318.00		2,416,027.00
Increase/(decrease) in stock of Finished goods and works-in-progress	19		-		-
TOTAL (A)			**169,170,319.00**		**121,934,063.67**
EXPENDITURE					
Establishment Expenses	20		71,627,645.00		50,025,735.00
Administrative Expenses etc.	21		106,099,057.67		93,829,960.40
Expenditure on Grants, Subsidies etc.	22		-		-
Interest	23		-		-
Depreciation (Net Total at the year-end -corresponding to Schedule 8)		183,153,848.00		27,880,054.00	
Less: Transferred to Grants-in-Aid		183,153,848.00	-	27,880,054.00	
Provision For Salaries and other Expenses (Annexure-J)			2,726,194.00		4,230,388.00
TOTAL (B)			**180,452,896.67**		**148,086,083.40**
Balance being excess of Expenditure over Income (A-B)			**-11,282,577.67**		**-26,152,019.73**
Transfer to Special Reserve (Specify each)					
Transfer to/from General Reserve					
Balance being SURPLUS/(DEFICIT) carried to CORPUS/CAPITAL FUND					
Significant Accounting Policies	24				
Contingent Liabilities and Notes on Accounts	25				

Dr Subeer S. Majumdar
Direcor
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Survey No.37, Opp:Journalist Colony, Near Gowlidoddi,
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For CHARY AND CO
Chartered Accountants
F R No. 014102S
M S Appala Chary
Chartered Accountant
M. No. 221442
CHARY & CO FRN: 014102S M.No.221442 CHARTERED ACCOUNTANTS

Harjit Singh
Sr. Manager (Admin & Finance)
NIAB
हरजीत सिंह/Harjit Singh
वरिष्ठ प्रबंधक (प्रशासन और वित्त)
Senior Manager (Admin & Finance)
राष्ट्रीय पशु जैव प्रौद्योगिकी संस्थान
National Institute of Animal Biotechnology
हैदराबाद/Hyderabad.

I Jagadeesh
Manager (Office & Finance)
NIAB
आई जगदीश/I Jagadeesh
प्रबंधक (कार्यालय और वित्त)
Manager (Office & Finance)
राष्ट्रीय पशु जैव प्रौद्योगिकी संस्थान
National Institute of Animal Biotechnology (NIAB)
हैदराबाद/Hyderabad.

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY, HYDERABAD
RECEIPTS AND PAYMENTS ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2020

(Amount - Rs.)

RECEIPTS	Current Year	Previous Year	PAYMENTS	Current Year	Previous Year
1.Opening Balances			1. Expenses		
a) Cash in hand	-	-	a) Establishment Expenses (corresponding to Schedule 20)	71,627,645.00	50,025,735.00
b) Bank Balances			b) Administrative Expenses (corresponding to Schedule 21)	106,099,057.67	93,829,960.40
i) In current accounts	-	-			
ii) In deposit accounts	-	-	2. Payments made against funds for various projects		
iii) Savings accounts	649,809.26	2,485,736.14	(Name of the fund or project should be shown along with the particulars of payments made for each project) Projects (Annexure F)	133,812,467.03	62,118,013.61
2. Grants Received					
a) From Government of India	280,800,000.00	535,000,000.00			
b) From State government	-	-	3. Investments and deposits made		
c) From other sources (details) (Grants for capital & revenue exp. To be shown separately)	-	-	a) Out of Earmarked/Endowment funds b) Out of Own Funds (Investments-Others) c) Investments	- - 321,000,000.00	- - 486,150,000.00
d) Projects (Annexure - C)	113,130,147.00	65,638,061.00		-	-
			4. Expenditure on Fixed Assets & Capital Work-in-Progress		
			a) Purchases of Fixed Assets:		
3. Income on Investments from			Books & Journals	19,629.00	73,333.00
a) Earmarked/Endow. Funds	-	-	Equipment -Lab/Office/Furniture	256,040,811.12	113,161,505.68
b) Own Funds (Oth. Investment)	-	-	b) Expenditure on Capital Work-in-Progress:	47,351,200.00	174,264,897.00
c) Investments Encashed	331,700,000.00	482,650,000.00			
			5. Refund of surplus money/Loans		
4. Interest Received			a) To the Government of India	-	-
a) On Bank deposits (Please Refer Schedule -17)	-	9,446,421.67	b) To the State Government	-	-
b) Loans, Advances etc.	-	-	c) To other providers of funds	-	-
c) on savings accounts	-	-			
d) Interest on LC	-	-	6. Finance Charges (Interest)	-	-
5. Other Income(Specify)			7. Other Payments (Specify)		
a) Analysis Charges	472,001.00	71,615.00	Advances (Annexure-D)	32,751,709.00	220,805,583.64
			I-Remittances (Annexure-E)	10,164,540.00	10,878,473.00
6. Amount Borrowed	-	-	CPF A/c / GPF A/c	1,260,000.00	1,185,000.00
			New Pension Scheme	3,406,508.00	2,895,805.00
7. Any Other Receipts(Give Details)					
I-Remittances (Annexure-A)	10,164,540.00	10,878,473.00			
CPF-SUB, Arrears and adv. Refund/GPF	1,260,000.00	1,185,000.00	8. Closing Balances		
Sundry Receipts	1,936,007.00	1,641,789.00	a) Cash in hand	-	-
Application Fee	19,026.00	81,323.00	b) Bank Balances		
Sale OF Tender Forms	628,500.00	567,500.00	i) In current accounts	-	-
License Fee	314,785.00	125,415.00	ii) In deposit accounts	-	-
NPS	3,406,508.00	2,895,805.00	iii) Savings accounts	599,371.45	649,809.26
Advance/Refunds/Recovery/ Ad(Annexure-B)	239,651,615.01	103,370,976.78			
TOTAL	**984,132,938.27**	**1,216,038,115.59**	**TOTAL**	**984,132,938.27**	**1,216,038,115.59**

Dr Subeer S. Majumdar
Direcor
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For CHARY AND CO
Chartered Accountants
F R No. 014102S

M S Appala Chary
Chartered Accountant
M. No. 221442

FRN : 014102S
M.No. 221442

Harjit Singh
Sr. Manager (Admin & Finance)
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हरजीत सिंह/Harjit Singh
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National Institute of Animal Biotechnology (NIAB)
हैदराबाद/Hyderabad.

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year		Previous Year	
SCHEDULE 1 - CORPUS/CAPITAL FUND :				
Balance as at the beginning of the year		1,866,087,121.45		1,485,149,559.52
Add : Contribution towards Corpus/Capital Fund				
NIAB Core - Plan (Non-Recurring)	115,000,000.00		425,000,000.00	
Capitalised portion of Capital Expenditure of projects	71,122,427.96		9,969,635.66	
Others	-	186,122,427.96	-	434,969,635.66
Less : Lump Sum Depreciation				
Less : Depreciation For the Year 2019-2020	183,153,848.00	183,153,848.00	27,880,054.00	27,880,054.00
Add : Balance of net income/(Expenditure) transferred		-11,282,577.67		-
Add : transferred from General Reserve Account (Schedule2)				-26,152,019.73
BALANCE AS AT THE YEAR - END		**1,857,773,123.74**		**1,866,087,121.45**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year		Previous Year	
SCHEDULE 2 -RESERVES AND SURPLUS :				
1.Capital Reserve :				
Opening Balance	-		-	
Addition during the year	-		-	
Less : Deductions during the year	-	-	-	-
2.Revaluation Reserve :				
Opening Balance	-		-	
Addition during the year	-		-	
Less : Deductions during the year	-	-	-	-
3.Special Reserves :				
Opening Balance	-		-	
Addition during the year	-		-	
Less : Deductions during the year	-	-	-	-
4.General Reserve :				
Opening Balance	-		-	
Addition during the year	-		-26,152,019.73	
Less : Deductions during the year	-	-	-	-26,152,019.73
Less: Transfer to Corpus Fund		-		26,152,019.73
Total		**-**		**-**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year		Previous Year	
SCHEDULE 3 - EARMARKED/ENDOWMENT FUNDS : (Refer Annexures)				
(a) Opening balance of the Funds		132,100,156.04		128,580,108.65
(b) Additions to the Funds :				
i. Donations / grants	109,285,453.00		60,638,138.00	
ii. Income from investments made on account of funds	-		-	
iii. Other additions	3,844,694.00	113,130,147.00	4,999,923.00	65,638,061.00
TOTAL (a+b)		**245,230,303.04**		**194,218,169.65**
(c) Utilisation/Expenditure towards objective of funds				
(i) Capital Expenditure (Refer Annexures I & II)				
- Fixed Assets	71,122,427.96		9,969,635.66	
- Others		71,122,427.96	-	9,969,635.66
- Total				
(ii) Revenue Expenditure (Refer Annexures I & II)				
- Salaries, Wages and allowances etc.				
- Rent	-		-	
- Other Expenses	62,690,039.07	62,690,039.07	52,148,377.95	52,148,377.95
Total				
TOTAL (c)		**133,812,467.03**		**62,118,013.61**
NET BALANCE AS AT THE YEAR-END [(a + b)-c]		**111,417,836.01**		**132,100,156.04**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year		Previous Year	
SCHEDULE 4 - SECURED LOANS AND BORROWINGS :				
1. Central Government		-		-
2. State Government (Specify)		-		-
3. Financial Institutions				
a) Term Loans	-		-	
b) Interest accrued and due	-	-	-	-
4. Banks :				
a) Terms Loans	-		-	
- Interest accrued and due	-		-	
b) Other Loans	-		-	
- Interest accrued and due	-	-	-	-
5. Other Institutions and Agencies		-		-
6. Debentures and Bonds		-		-
7. Others (Specify)		-		-
TOTAL		-		-
Note: Amount due within one year				

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year		Previous Year	
SCHEDULE 5 - UNSECURED LOANS AND BORROWINGS :				
1. Central Government		-		-
2. State Government (Specify)		-		-
3. Financial Institutions		-		-
4. Banks :				
a) Terms Loans	-		-	
b) Other Loans	-	-	-	-
5. Other Institutions and Agencies		-		-
6. Debentures and Bonds		-		-
7. Fixed Deposits		-		-
8. Others (Specify)		-		-
TOTAL		-		-
Note: Amount due within one year				

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year		Previous Year	
SCHEDULE 6 - DEFFERED CREDIT LIABILITIES :				
a) Acceptances secured by hypothecation of capital equipment and other assets		-		-
b) Others		-		-
TOTAL		-		-
Note: Amount due within one year				

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year		Previous Year	
SCHEDULE 7 - CURRENT LIABILITIES AND PROVISIONS :				
A. CURRENT LIABILITIES				
1. Acceptances	-		-	
2. Sundry Creditors	-		-	
3. Advances Received (including interest to be returned. Ref Sch-17)	13,917,763.15	13,917,763.15	-	-
4. Interest accrued but not due	-			
5. Statutory Liabilities	-			
6. Other current Liabilities				
NIAB.CP Fund A/C	-		-	
EMD	-		-	
Security Deposit	3,148,855.00	3,148,855.00	917,829.00	917,829.00
TOTAL (A)		**17,066,618.15**		**917,829.00**
B.PROVISIONS				
1. For Taxation	-			
2. Gratuity				
3. Superannuation/Pension				
4. Accumulated Leave Encashment & Gratuity	1,137,008.00		-	
5. Trade Warranties/Claims				
6. Others (Specify) (Annexure-G)	10,814,779.00	11,951,787.00	8,088,585.00	8,088,585.00
TOTAL (B)		**11,951,787.00**		**8,088,585.00**
TOTAL (A+B)		**29,018,405.15**		**9,006,414.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

SCHEDULE 8 - FIXED ASSETS :

Particulars	GROSS BLOCK				DEPRECIATION				NET BLOCK	
	Cost/valuation As at beginning of the year	Addition during the year	Deductions during the year	Cost/valuation at the year end	As at the beginning of the year	On additions during the year	On Deductions during the year	Total up to the year end	As at the Current year end	As at the Previous year end
A. FIXED ASSETS:										
1. LAND:										
a) Freehold ***	1.00	-	-	1.00	-	-	-	-	1.00	1.00
b) Leasehold	-	-	-	-	-	-	-	-	-	-
2. BUILDINGS				-				-	-	
a) On Freehold Land	-	1,132,345,605.00	-	1,132,345,605.00	-	113,234,561.00	-	113,234,561.00	1,019,111,044.00	-
b) On Leasehold Land	-	-	-	-	-	-	-	-	-	-
c) Ownership Flats/Premises	-	-	-	-	-	-	-	-	-	-
d) Superstructures on Land	-	-	-	-	-	-	-	-	-	-
not belongs to the entity				-				-	-	
3. PLANT MACHINERY & EQUIPMENT	252,985,039.08	314,534,034.08	-	567,519,073.16	102,959,595.00	62,121,846.00	-	165,081,441.00	402,437,632.16	150,025,444.08
4. VEHICLES	7,558,885.29	170,000.00	-	7,728,885.29	2,448,267.00	792,093.00	-	3,240,360.00	4,488,525.29	5,110,618.29
5. FURNITURE, FIXTURES	31,149,397.00	3,194,442.00	-	34,343,839.00	2,236,105.00	3,210,773.00	-	5,446,878.00	28,896,961.00	28,913,292.00
6. OFFICE EQUIPMENT	14,321,142.00	4,452,196.00	-	18,773,338.00	3,468,864.00	2,194,760.00	-	5,663,624.00	13,109,714.00	10,852,278.00
7. COMPUTER/PERIPHERALS	2,229,037.00	1,521,276.00	-	3,750,313.00	2,153,782.00	334,357.00	-	2,488,139.00	1,262,174.00	75,255.00
8. ELECTRIC INSTALLATIONS	-			-	-	-	-	-	-	
9. LIBRARY BOOKS	696,731.00	19,629.00	-	716,360.00	692,671.00	13,875.00	-	706,546.00	9,814.00	4,060.00
10. TUBEWELLS & WATER SUPPLY	-			-	-	-	-	-	-	
11. OTHER FIXED ASSETS	7,521,500.00	3,291,291.00	-	10,812,791.00	1,676,776.00	1,251,583.00	-	2,928,359.00	7,884,432.00	5,844,724.00
TOTAL	**316,461,732.37**	**1,459,528,473.08**	**-**	**1,775,990,205.45**	**115,636,060.00**	**183,153,848.00**	**-**	**298,789,908.00**	**1,477,200,297.45**	**200,825,672.37**
B. CAPITAL WORK-IN-PROGRESS	1,472,741,778.00	47,351,200.00	1,132,345,605.00	387,747,373.00	-	-	-	-	387,747,373.00	1,472,741,778.00
TOTAL	**1,789,203,510.37**	**1,506,879,673.08**	**1,132,345,605.00**	**2,163,737,578.45**	**115,636,060.00**	**183,153,848.00**	**-**	**298,789,908.00**	**1,864,947,670.45**	**1,673,567,450.37**

***** LAND OF 100 ACRES ALLOTTED BY GOVT. OF AP. WORTH OF RS. 306.822 CRORES TO NIAB AT FREE OF COST VIDE G.O.MS.NO. 566, DT. 13/09/2012 AT SY NO. 37, GOPANAPALLY VILLAGE, SERILINGAMPALLY VILLAGE, R R DIST. *****

Assets bifurcation by funding :

Core grant	**1,772,146,084.86**	**1,435,757,245.12**	**1,132,345,605.00**	**2,075,557,724.98**	**113,025,711.00**	**171,927,955.00**	**-**	**284,953,666.00**	**1,790,604,058.98**	**1,659,120,373.86**
Extra mural projects	**17,057,425.51**	**71,122,427.96**	**-**	**88,179,853.47**	**2,610,349.00**	**11,225,893.00**	**-**	**13,836,242.00**	**74,343,611.47**	**14,447,076.51**
TOTAL	**1,789,203,510.37**	**1,506,879,673.08**	**1,132,345,605.00**	**2,163,737,578.45**	**115,636,060.00**	**183,153,848.00**	**-**	**298,789,908.00**	**1,864,947,670.45**	**1,673,567,450.37**

Capital Work in Progress worth of Rs 113,23,45,605.00/- has been capitalized to Buildings during the FY 2019-20.

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 9 - INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS :		
1. In Government Securities	-	-
2. Other approved securities	-	-
3. Shares	-	-
4. Debentures and Bonds	-	-
5. Subsidiaries and Joint Ventures	-	-
6. Others (to be specified) - STDRs	111,417,836.01	132,100,156.04
TOTAL	**111,417,836.01**	**132,100,156.04**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 10 - INVESTMENTS - OTHERS :		
1. In Government Securities	-	-
2. Other approved securities	-	-
3. Shares	-	-
4. Debentures and Bonds	-	-
5. Subsidiaries and Joint Ventures	-	-
6. Others (to be specified) - STDRs	13,382,163.99	3,399,843.96
TOTAL	**13,382,163.99**	**3,399,843.96**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year		Previous Year	
SCHEDULE 11 - CURRENT ASSETS, LOANS, ADVANCES ETC.:				
A. CURRENT ASSETS				
1. Inventories				
a) Stores and Spares	-		-	
b) Loose Tools	-		-	
c) Stock-in-trade				
Finished Goods	-		-	
Work-in-progress	-		-	
Raw Materials	-	-	-	-
2. Sundry Debtors:		-		
a) Debts Outstanding for a period exceeding six months			-	
b) Others-Life Membership Fees	-	-	-	-
3. Cash balances in hand (including cheques/drafts and imprest)				-
4. Bank Balances:				
a) With Scheduled Banks:				
-On Current Accounts	-		-	
-On Deposit Accounts (includes margin money)	-		-	
-On Savings Accounts	599,371.45	599,371.45	649,809.26	649,809.26
b) With non-Schedules Banks:				
-On Current Accounts	-		-	
-On Deposit Accounts	-		-	
-On Savings Accounts	-	-	-	-
5. Post Office-Savings Accounts				-
TOTAL (A)		**599,371.45**		**649,809.26**
B. LOANS, ADVANCES AND OTHER ASSETS				
1. Loans:				
a) Staff	-		-	
b) Other Entities engaged in activities/objectives similar to that of the Entity	-	-	-	-
2. Advances and other amounts recoverable in cash or in kind or for value to be received				
a) On Capital Account (Annexure-H)	7,512,070.00		195,922,788.86	
b) Prepayments - Deposits (Annexure-I)	350,253.00		1,553,643.00	
c) Others	-	7,862,323.00	-	197,476,431.86
3. Income Accrued:				
a) On Investments from Earmarked/Endowments Funds	-		-	
b) On Investments - Others	-		-	
c) On Loans and Advances	-		-	
d) Others	-	-	-	-
4. Claims Receivable				-
TOTAL (B)		**7,862,323.00**		**197,476,431.86**
TOTAL (A+B)		**8,461,694.45**		**198,126,241.12**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 12 - INCOME FROM SALES/SERVICES :		
1) Income from sales		
a) Sale of Finished Goods	-	-
b) Sale of Raw Material	-	-
c) Sale of Scraps	-	-
2) Income from Services		
a) Labour and Processing Charges	-	-
b) Professional/Consultancy Services (Analysis Charges)	472,001.00	71,615.00
c) Agency Commission and Brokerage	-	-
d) Maintenance Services (Equipment/Property)	-	-
e) Others (Specify)	-	-
TOTAL	**472,001.00**	**71,615.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 13 - GRANTS/SUBSIDIES :		
(Irrevocable Grants & Subsides Received)		
1) Central Government (DBT Plan Grant-in-Aid)	165,800,000.00	110,000,000.00
2) State Government(s)	-	-
3) Government Agencies	-	-
4) Institutions/Welfare Bodies	-	-
5) International Organisations	-	-
6) Others (Specify)	-	-
TOTAL	**165,800,000.00**	**110,000,000.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 14 - FEES/SUBSCRIPTIONS :		
1) Entrance Fees	-	-
2) Annual Fees/Subscriptions	-	-
3) Seminar/Program Fees	-	-
4) Consultancy Fees	-	-
5) Others (Specify)	-	-
TOTAL	**-**	**-**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Investments from Earmarked Fund		Investments-Others	
SCHEDULE 15 - INCOME FROM INVESTMENTS :	**Current Year**	**Previous Year**	**Current Year**	**Previous Year**
(Income on Invest. from Earmarked/Endowment Funds transferred to Funds)				
1) Interest:				
a) On Govt. Securities	-	-	-	-
b) Other Bonds/Debentures	-	-	-	-
2) Dividends:				
a) On Shares	-	-	-	-
b) On Mutual Fund Securities	-	-	-	-
3) Rents	-	-	-	-
4) Others (Specify) STDRs	-	-	-	-
TOTAL	**-**	**-**	**-**	**-**
TRANSFERRED TO EARMARKED/ENDOWMENT FUNDS				

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 16 - INCOME FROM ROYALTY, PUBLICATION ETC. :		
1) Income from Royalty	-	-
2) Income from Publications	-	-
3) Others (Specify)	-	-
TOTAL	**-**	**-**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars		Current Year	Previous Year
SCHEDULE 17 - INTEREST EARNED :			
1) On Term Deposits			
a) With Schedule Banks #	12,991,993.70	-	9,446,421.67
Less : Transferred to Advances Received under Current Liabilities under Schedule-7	-12,991,993.70		
b) With Non-Scheduled Banks		-	-
c) With Institutions		-	-
d) Others		-	-
2) On Saving Accounts			
a) With Scheduled Banks		-	-
b) With Non-Scheduled Banks		-	-
c) Post Office Savings Accounts		-	-
d) Others		-	-
3) On Loans			
a) Employees/Staff		-	-
b) Others		-	-
4) Interest on Debtors and Other Receivables		-	-
TOTAL		**-**	**9,446,421.67**
Note :- Tax deducted at source to be indicated			

An amount of Rs.1,29,91,993.70/- earned as interest on Core grant during 2019-20 has been shown as Current Liability under Advances Received in Schedule-7 as the interest earned on Grants in aid or advances should be mandatorily remitted to the Consolidated Fund of India immediately after finalisation of the accounts as per the GRF Rule 230 (8).

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 18 - OTHER INCOME :		
1) Profit on Sale/disposal of Assets:	-	-
a) Owned assets	-	-
b) Assets acquired out of grants, or received free of cost	-	-
2) Export Incentives realized	-	-
3) Fees for Miscellaneous Services	-	-
4) Miscellaneous Receipts	1,673,737.00	1,575,167.00
5) Other Receipts		
Sundry Receipts	262,270.00	66,622.00
Application Fee	19,026.00	81,323.00
Sales Of Tender Forms	628,500.00	567,500.00
Licence Fee	314,785.00	125,415.00
Interest On Computer Advance, Conveyance Advance And HBA	-	-
Leave Salary-Pension Contribution	-	-
Provident Fund Salvage	-	-
Free. Gifts-Donations	-	-
TOTAL	**2,898,318.00**	**2,416,027.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 19 - INCREASE/DECREASE IN STOCK OF FINISHED GOODS & WORK IN PROGRESS :		
a) Closing stock		
-Finished Goods	-	-
-Work-in-progress	-	-
Total (a)	**-**	**-**
b) Less: Opening stock		
-Finished Goods	-	-
-Work-in-progress	-	-
Total (b)		**-**
NET INCREASE/(DECREASE) [a-b]	-	-

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 20 - ESTABLISHMENT EXPENSES :		
a) Salaries and Wages	35,785,887.00	32,534,854.00
b) Allowances and Bonus	18,431,657.00	13,398,888.00
c) Contribution to Provident Fund	784,418.00	270,000.00
d) Contribution to Other Fund (NPS)	3,410,221.00	2,912,525.00
e) Staff Welfare Expenses - Medical charges	1,037,231.00	798,238.00
f) Expenses on Employees Retirement and Terminal Benefits	12,178,231.00	111,230.00
g) Others	-	-
TOTAL	**71,627,645.00**	**50,025,735.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 21 - OTHER ADMINISTRATIVE EXPENSES :		
a) Purchases	12,848,636.00	27,545,105.00
b) Electricity and power	22,154,269.00	13,373,985.00
c) Water charges	8,244,894.00	258,314.00
d) Insurance	144,252.00	212,394.00
e) Repairs and maintenance	6,099,841.00	4,353,493.00
f) Rent, Rates and Taxes	6,516,938.00	14,181,922.00
g) Vehicles Running and Maintenance	1,229,951.64	1,268,857.33
h) Postage, Telephone and Communication Charges	1,308,977.00	551,220.67
i) Printing and Stationary	1,125,046.00	871,591.50
j) Travelling and Conveyance Expenses	1,915,501.00	2,518,354.00
k) Expenses on Seminar/Workshops	813,944.00	463,942.00
l) Subscription Expenses	-	-
m) Expenses on Fees	-	-
n) Auditors Remuneration	60,000.00	35,400.00
o) Hospitality Expenses	188,164.00	217,694.00
p) Professional Charges	-	-
q) Advertisement and Publicity	242,545.00	660,415.00
r) Bank Charges	7,689.13	39,873.89
s) Security & Cleaning Contract Charges	29,768,587.00	19,006,824.00
t) Training Course /Symposia	14,000.00	-
u) Other Contingencies	11,624,497.90	4,182,993.00
v) Liveries & Blankets	-	-
w) Other Research Expenses	1,788,805.00	4,075,986.01
x)Office Books	2,520.00	11,596.00
TOTAL	**106,099,057.67**	**93,829,960.40**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 22 - EXPENDITURE ON GRANTS, SUBSIDIES ETC.:		
a) Grants given to Institutions/Organisations	-	-
b) Subsidies given to Institutions/Organisations	-	-
TOTAL	**-**	**-**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
SCHEDULES FORMING PART OF INCOME & EXPENDITURE AS AT 31st MAR 2020

(Amount - Rs.)

Particulars	Current Year	Previous Year
SCHEDULE 23 - INTEREST :		
a) On Fixed Loans	-	-
b) On Other Loans (including Bank Charges)	-	-
c) Others	-	-
TOTAL	**-**	**-**

Schedule 24: Significant Accounting Policies &

Schedule 25: Contingent Liabilities & Notes on Account for the period ended 31/03/2020

1. Method of Accounting:

a. The accounting system adopted by the organization is on "Accrual basis".
b. The organization has been allocated grant-in-aid under the "Non-recurring" & "Recurring" heads in 3 categories grant-in-aid for Capital Assets, grant-in-aid General, grant-in-aid Salaries.

2. Revenue recognition:

Income comprises of Grant-in-Aid, Internal Resources through services and User charges and interest from short term deposits. Income accounted on the basis of the Cash/DD/Cheques/Cr notes received.

3. Fixed Assets:

a. Fixed assets are stated at cost. Cost includes freight, duties, and taxes etc.,
b. Depreciation: Based on the recommendation of the Finance Committee and approval of the Governing Body of the Institute, Depreciation Account on Fixed Assets has been prepared at the rate prevailing to the concerned Fixed Assets as specified in the Income Tax Act, 1961 on Written Down Value Method of Depreciation. This has been set off against the Grant in Aid (Non Recurring) in the concerned account.
c. Capital work in progress has been entered to the extent of the last running account bills paid.
d. Realization on sale of obsolete/surplus fixed assets which is not required for the purpose of research activities are adjusted against capital cost.

4. Inventories:

All purchases of chemicals, glassware and other consumables have been charged to consumption at the time of purchase.

5. Foreign Currency transactions:

Foreign Currency transactions are recognized in the books at the exchange rates prevailing on the actual date of transaction.

6. Investments:

Investments in STDR's are stated at book values.

7. Terminal benefits of employees:

Contributions to New Pension Scheme (Defined Contribution Plans) are Charged to income and expenditure account as per applicable rules. Provision towards Leave Encashment and Gratuity (Defined benefit Plan) is made on actuarial valuation carried out by Life Insurance Corporation of India as stated in AS-15 (Revised) –"Accounting for Retirement Benefits". The Society has covered its Leave Encashment and Gratuity Liability with Life Insurance Corporation of India (LIC) and contributions are made to LIC on yearly basis.

8. The previous year balances have been regrouped / rearranged, wherever necessary.

For CHARY AND CO
Chartered Accountants
F R No. 014102S

Director, NIAB	**Sr. Manager (Admin & Finance), NIAB**	**Manager (Office & Finance), NIAB**	**M S APPALA CHARY FCA M.No.221442**

Place: Hyderabad
Date: 07/07/2020

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
HYDERABAD

CLARIFICATION ON NOTES ON ACCOUNTS: 2019-20

- **Notes on Accounts 1 to 2 & 4 to 8:** Method of Accounting / Revenue recognition / Fixed Asset/ Inventories / Foreign Currency transactions / Investments:

  These are all only informatory items.

- **Notes on Accounts 3: Fixed Assets:**

  Depreciation has been calculated on Written Down Value method and at the rates prevailing to the concerned Fixed Asset as specified on the Income Tax Act, 1961 and set off against the Grant-in-aid (non-recurring). The details of the Depreciation on Fixed Assets are at Schedule – 8 is an integral part of the financial statements.

Harjit Singh
Senior Manager (Admin &Finance)

I Jagadeesh
Manager (Office & Finance)

Place: Hyderabad
Date: 07/07/2020

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
Details of Closing balances of various Earmarked / Endowement Funds (Refer Sch-3)
For the Year Ended 31st MAR 2020

Annexure-I (Amount in Rs.)

Previous year	Proj No	Particulars	Current Year
76,022.67	FS 013 (MVS)	SERB - Post Doctoral Fellowship	-0.00
165,499.00	FS003(PJ)	DST - INSPIRE Fellowship	219,589.00
86,083.00	FS005(NAT)	DBT JRF	61,083.00
22,500.00	FS-007(PB)	Junior Research Fellow (RSP)	12,856.00
60,000.00	FS-011(SR)	DBT-JRF Fellowship	176,986.00
59,999.00	FS016(DD)	DBT JRF	1,921.00
86,188.00	FS017(AD)	DBT JRF	96,901.00
110,000.00	FS018(PPK)	DST INSPIRE Fellowship	70,267.00
-	FS020(VG)	Generation of recombinant therapeutics in animal bioreactors for increasing affordability and improvement of human health.	16,667.00
458,500.00	FS023 (NH)	SERB	479,310.00
-	FS024(RK)	DBT-JRF	20,000.00
26.00	FS025(PG)	DBT-JRF	150.00
-	FS026(SN)	ICMR	58,400.00
-	FS027(KRA)	DBT- JRF	39,552.00
-	FS028(LK)	DBT-JRF	40,416.00
-	FS029(AR)	DST-INSPIRE FELLOWSHIP	95,353.00
-	FS030(VPV)	CSIR - Fellowship	11,640.00
-	FS031(MA)	DBT-Research Associate-I	80,264.00
-	FS032(PS)	CSIR - Fellowship	159.00
-	FS033(MRP)	CSIR - Fellowship	19.00
-	FS034(SM)	CSIR - Fellowship	219.00
-	FS035(PJM)	CSIR - Fellowship	10,000.00
-	FS036(KJ)	Identification and characterization of novel host targets for developing improved therapeutics for the zoonotic disease, Brucellosis.	98,200.00
477,903.50	SP002	Characterization of Cell Cycle regulators associated with DNA replication machinery in Toxoplasma Gondii - DST INSPIRE Faculty	77,504.50
740,488.00	SP003	Understanding the host response and molecular pathogenesis of Leptospira interrogans infection - Ramalingaswamy Fellowship	-
124,514.00	SP004	Evaluation of Anti-inflammatory Natural Compounds for Therapeutic use in Mastitis of Dairy Animals - NMPB	128,917.00
-62,034.00	SP005	Role of gamma delta T cells in inflammation - DST Women Scientist Scheme	-62,034.00
267,305.00	SP007(PS)	Identification of disease related markers for the diagnosis of Subclinical Mastitis	-
832,839.00	SP008(GKR)	Understanding the immune mechanism of host disease and development of marker vaccines and DIVA test for Peste des Petits ruminants	-
188,636.00	SP011(PS)	Genome-wide association study for identification of novel loci associated with resistance to Theileriosis in India	-
224,761.00	SP013(GKR)	To develop novel therapeutics for brucellosis: Identification and characterization of host factors supporting Brucella replication	-
49,740.00	SP014(PS)	Identification of Virulence factors associated with Theileria annulata infection in Indian Cattle	290,265.00

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
Details of Closing balances of various Earmarked / Endowement Funds (Refer Sch-3)
For the Year Ended 31st MAR 2020

Annexure-I (Amount in Rs.)

Previous year	Proj No	Particulars	Current Year
1,007,463.00	SP015(MS)	A Study to Understand the genetic variations among the field isolates of porcine circo viruses from piggery farms in Mizoram, with ultimate aim to engineer an effective recombinant chimeric DIVA vaccine	365,497.00
15,014.00	SP016 (VB)	DST INSPIRE FACULTY-Charterization of transglycosylases associated with cell wall biogenesis in Vancomycin resistant Staphylococcus aureus	206,638.00
628,811.00	SP017 (AS)	Elucidation of mechanism(s) of transformation of host cells by Theileria annulata	108,397.00
888,038.00	SP018 (SM)	Towards establishing an efficient animal-based production of thrapeutic Protein in Milk of farmed animals using various modes of gene delivery	260,698.00
735,044.96	SP019	Development of peptide based anti-inflammatory drug for septicemia	590,375.96
648,726.00	SP020(AS)	Evaluation of medicinal plant extracts for anti-tick activity and identification of active compounds	708,324.00
135,782.00	SP022 (NRH)	Development, testing and evaluation of whole and recombinant antigen-based ELISA for monitoring the health of laboratory animals Phase -II	727,665.00
56,012.00	SP023 (NRH)	Molecular epidemiology and genomics of mastitis-associated staphylococci	-
92,452,838.58	SP024(SSM)	Genomics for conservation of indigenous cattle breeds and for enhancing milk yield, Phase -I	71,195,033.67
466,459.00	SP025 (SF)	Random and Targeted mutagenesis of zoonotic pathogen Leptospira interrogans: In perspective of vaccine development"	280,036.00
490,809.00	SP026 (SS)	Integrated Biotechnological Approach towards Improvement of Quality and Productivity of Tropical Tasar Silk	373,938.00
325,402.00	SP027(PS)	Aptamer based lateral flow device for the detection of heat or estrous in buffalo	434,891.00
415,695.00	SP028(BD)	The Ramanujan Fellowship	24,196.00
387,152.00	SP029(GKR)	To understand the role of Cytoplasmic linker protien-170 in the down-regulation of TLR4 signaling	255,371.00
3,561,423.00	SP030(SSM)	Genome ending for generating semen favoring production of cow.	492,770.00
382,106.68	SP031(HBD)	"Unraveling Molecular Mechanisms of Homologues recombination and Germ cell maintenance to prevent Birth Defects, Extend Human and livestock Fertility"	149,088.68
59,466.00	SP032(NRH)	"DBT-GADVASU Canine Research Centre and Networks"	60,344.00
1,468,738.00	SP033(SSM)	JC Bose National Fellowship	901,439.00
1,051,059.00	SP034(SSM)	"An attempt to generate transgenic pig through testicular transgenesis or male germ cell transplantation to enhance productivity"	265,675.00
56,840.60	SP035(PS)	"Development of point -of-care diagnostics for detection of venom proteins of Naja Naja Cobra and Bungarus caeruleus Krait in envenomed animals"	-114,657.67
4,112,302.00	SP036(NG)	Feasibility of producing cattle gonadotropins in milk of rabbit by invivo gene transfection	804,110.00
928,738.14	SP037(NG)	Establishment of goat mammary epithelial/stem cell lines for the production of pharmaceutical interest proteins	379,892.71

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
Details of Closing balances of various Earmarked / Endowement Funds (Refer Sch-3)
For the Year Ended 31st MAR 2020

Annexure-I (Amount in Rs.)

Previous year	Proj No	Particulars	Current Year
1,289,122.00	SP038(VB)	To investigate the mechanisms regulating the enigmatic ..... staphylococcus aureus	1,106,707.00
213,942.00	SP039(SF)	Development of Novel Mucosal Delivery System and Testing its Efficacy Against Salmonella Infection	11,781.00
5,758,438.00	SP040(NRH)	Chicken or egg: Drivers of antimicrobial resistance in poultry in India	2,154,949.00
154,124.00	SP041(GKR)	"Understanding the mechanism of host innate immune suppression by the Brucella effector protein, TcpB to identify novel drug targets for brucellosis"	164,223.00
366,511.00	SP042(MS)	"Molecular platform for pidemiology, disease mapping and development of diagnostics for economically important diseases of ducks."	14,240.00
3,158,825.00	SP043(AKG)	Development of injectable nanofibrous implant for oestrus synchronization in cattle.	1,887,785.00
1,520,079.91	SP044(PS)	Understanding the Epigenetics of Host Pathogen interaction during Bovine Theileriosis"	338,002.00
1,740,875.00	SP045(ASD)	Characterization of spliceosome- associated Nine Teen complex (NTC) like proteins in Toxoplasma Gondii.	69,354.00
1,785,695.00	SP046(SF)	Immunocharaterization of Lipopolysaccharide (LPS) from Leptospira:Towards develepment LPS based Vaccine."	161,908.00
164,323.00	SP047(SG)	"Development of peptide functionalized gold nanoparticles for efficient targeting and imaging of urokinase plasminogen activator receptor (uPAR) in cancer diagnostics"	76,261.00
674,546.00	SP048(SG)	"Iron oxide nanoparticles peptide complexes for imaging of urokinase plasminogen activator receptor (uPAR) in cancer diagnostics."	389,281.00
1,030,785.00	SP049(ASD)	"Development of lateral flow based chromatographic immunoassay using recombinant chimera antigens for point of care testing of Toxoplasma gondii infection."	1,149,011.00
-	SP050(AS)	"Establishment of genome manipulation technology in Theileria parasite for identification of gene involved in transformartion of host cell."	551,783.00
-	SP051(RKG)	"Genomics assisted pathobiology to identify novel targets for diagnosis and therapeutic intervention(s) of Japanese encephalitis and Leptospirosis"	11,897,080.16
-	SP052(HBD)	"Development of large animal models and Polyherbal medicines to treat ovarian cysts in livestock"	347,372.00
-	SP053(PD)	"Identification and characterization of virulence factors of Aspergillus fumigatus field isolates from poultry chicken".	1,173,560.00
-	SP054(VB)	Deciphering the role of efflux pumps in imparting antimicrobial resistance in staphylococcus aureus and their inhibitors in potentiating the existing therapy.	765,778.50
-	SP055(BD)	Limiting antimicrobial resistance by inhibiting diadenylate cyclase (DAC)- a bacterial second messenger biosynthetic enzyme involved in biofilm formation and cell wall intgrity.	898,225.50
-	SP056(SM)	Understanding the mechanism of buparvaquone resistance in apiomplexan parasite theileriaannulata.	376,237.00

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
Details of Closing balances of various Earmarked / Endowement Funds (Refer Sch-3)
For the Year Ended 31st MAR 2020

Annexure-I (Amount in Rs.)

Previous year	Proj No	Particulars	Current Year
-	SP057(HBD)	An attempt to enhance the shelf life of an oocyte to increase the fertilazition time window.	4,381,715.00
-	SP058(SA)	Identification of key molecular factors involved in resistance/ susceptibility to paratuberclosis infection in indigenous breeds of cows	1,769,556.00
-	SP059(MS)	Molecular biological studies on porcine reproductive & respiratory syndrome (PRRS) virus in pig population of North East Region of India for development of sustainable diagnostics and vaccine.	1,238,700.00
132,100,156.04		**TOTAL**	**111,417,836.01**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
Details of Fixed Assets Fund (Capitalised Portion of Project Grants)
For the Year Ended 31st MAR 2020

Annexure-II (Amount in Rs.)

Previous year	Proj No	Particulars	Current Year
267,266.33	FS 013 (MVS)	SERB - Post Doctoral Fellowship	-
-	FS023 (NH)	SERB	67,519.00
-	SP002	Characterization of Cell Cycle regulators associated with DNA replication machinery in Toxoplasma Gondii - DST INSPIRE Faculty	96,000.00
196,776.00	SP003	Understanding the host response and molecular pathogenesis of Leptospira interrogans infection - Ramalingaswamy Fellowship	228,225.00
105,000.00	SP016 (VB)	DST INSPIRE FACULTY-Charterization of transglycosylases associated with cell wall biogenesis in Vancomycin resistant Staphylococcus aureus	-
13,617.00	SP017 (AS)	Elucidation of mechanism(s) of transformation of host cells by Theileria annulata	-
134,670.00	SP018 (SM)	Towards establishing an efficient animal-based production of thrapeutic Protein in Milk of farmed animals using various modes of gene delivery	-
622,013.00	SP019	Development of peptide based anti-inflammatory drug for septicemia	-
83,574.00	SP020(AS)	Evaluation of medicinal plant extracts for anti-tick activity and identification of active compounds	-
4,703,501.33	SP024(SSM)	Genomics for conservation of indigenous cattle breeds and for enhancing milk yield, Phase -I	40,566,626.00
-	SP025 (SF)	Random and Targeted mutagenesis of zoonotic pathogen Leptospira interrogans: In perspective of vaccine development"	1,589,782.00
1,467,480.00	SP026 (SS)	Integrated Biotechnological Approach towards Improvement of Quality and Productivity of Tropical Tasar Silk	-
1,074,153.00	SP027(PS)	Aptamer based lateral flow device for the detection of heat or estrous in buffalo	-
-	SP028(BD)	The Ramanujan Fellowship	489,811.00
400,000.00	SP029(GKR)	To understand the role of Cytoplasmic linker protien-170 in the down-regulation of TLR4 signaling	-

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
Details of Fixed Assets Fund (Capitalised Portion of Project Grants)
For the Year Ended 31st MAR 2020

Annexure-II (Amount in Rs.)

Previous year	Proj No	Particulars	Current Year
-	SP030(SSM)	Genome ending for generating semen favoring production of cow.	2,316,328.00
9,227.00	SP031(HBD)	"Unraveling Molecular Mechanisms of Homologues recombination and Germ cell maintenance to prevent Birth Defects, Extend Human and livestock Fertility"	-
-	SP033(SSM)	JC Bose National Fellowship	1,258,777.00
-	SP034(SSM)	"An attempt to generate transgenic pig through testicular transgenesis or male germ cell transplantation to enhance productivity"	426,518.00
60,500.00	SP035(PS)	"Development of point -of-care diagnostics for detection of venom proteins of Naja Naja Cobra and Bungarus caeruleus Krait in envenomed animals"	428,351.67
-	SP036(NG)	Feasibility of producing cattle gonadotropins in milk of rabbit by invivo gene transfection	2,196,365.00
-	SP037(NG)	Establishment of goat mammary epithelial/stem cell lines for the production of pharmaceutical interest proteins	2,210,312.29
188,160.00	SP038(VB)	To investigate the mechanisms regulating the enigmatic ..... staphylococcus aureus	745,859.00
-	SP040(NRH)	Chicken or egg: Drivers of antimicrobial resistance in poultry in India	2,149,980.00
535,500.00	SP043(AKG)	Development of injectable nanofibrous implant for oestrus synchronization in cattle.	1,137,150.00
-	SP044(PS)	Understanding the Epigenetics of Host Pathogen interaction during Bovine Theileriosis"	1,264,143.00
36,066.00	SP045(ASD)	Characterization of spliceosome- associated Nine Teen complex (NTC) like proteins in Toxoplasma Gondii.	1,041,795.00
-	SP046(SF)	Immunocharaterization of Lipopolysaccharide (LPS) from Leptospira:Towards develepment LPS based Vaccine."	1,147,191.00
72,132.00	SP048(SG)	"Iron oxide nanoparticles peptide complexes for imaging of urokinase plasminogen activator receptor (uPAR) in cancer diagnostics."	342,732.00
-	SP050(AS)	"Establishment of genome manipulation technology in Theileria parasite for identification of gene involved in transformartion of host cell."	199,710.00
-	SP051(RKG)	"Genomics assisted pathobiology to identify novel targets for diagnosis and therapeutic intervention(s) of Japanese encephalitis and Leptospirosis"	9,689,669.00
-	SP052(HBD)	"Development of large animal models and Polyherbal medicines to treat ovarian cysts in livestock"	1,000,000.00
-	SP053(PD)	"Identification and characterization of virulence factors of Aspergillus fumigatus field isolates from poultry chicken".	120,200.00
-	SP055(BD)	Limiting antimicrobial resistance by inhibiting diadenylate cyclase (DAC)- a bacterial second messenger biosynthetic enzyme involved in biofilm formation and cell wall intgrity.	409,384.00
9,969,635.66		**TOTAL**	**71,122,427.96**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: A Forming part of Receipts and Payment a/c

(Amount-Rs.)

Previous Year	Particulars	Current Year
	I-Remittances	
5,062,715.00	Income Tax	6,368,316.00
6,795.00	Others (I-Remittances)	7,260.00
100,100.00	Professional Tax	123,150.00
5,708,863.00	TDS	3,665,814.00
10,878,473.00	**TOTAL**	**10,164,540.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: B Forming part of Receipts and Payment a/c

(Amount-Rs.)

Previous Year	Particulars	Current Year
	Advance refunds/recovery/Adjustments.	
232,157.00	LTC [Advance]	171,543.00
208,452.00	TA India & Abroad [Advance]	41,577.00
3,285.00	Telephone [Advance]	192,753.00
910,380.00	Rent [Advance]	941,640.00
25,000.00	Office Books [Advance]	10,000.00
-	Transport maintenance [Advance]	39,000.00
40,338.00	Printing & Stationery [Advance]	35,000.00
157,523.00	Insurance [Advance]	23,906.00
860,169.00	Others [Contingencies Advance]	469,040.00
525,246.00	Others [Maintenance Advance]	382,484.00
6,365,387.00	Chemicals [Advance]	-
3,854,064.00	Consumables, glassware and Spares [Advance]	164,498.00
233,100.00	Software [Advance]	-
15,000.00	Scientific Workshops Symposiums Seminars [Advance]	25,000.00
2,363,040.00	Other Research Expenses [Advance]	305,000.00
35,720.00	Lands and Buildings [Advance]	-
11,270,587.00	Works and Services [Advance]	649,000.00
37,224,053.78	Equipment [Advance]	202,437,788.86
-	Major Software [Advance]	21,275.00
3,660,590.00	Vehicles [Advance]	170,000.00
6,600,062.00	Office Equipment [Advance]	86,922.00
5,089,080.00	Furniture [Advance]	-
16,876,021.00	General Deposits And Advances	14,796,915.15
779,462.00	Security Deposit	6,297,091.00
85,091.00	Revolving Advance	102,612.00
5,957,169.00	GDA [Others]	-
-	Prepaid Expenses	151,562.00
-	Leave Encashment and gratuity provision	12,137,008.00
103,370,976.78	**TOTAL**	**239,651,615.01**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: C Forming part of Receipts and Payment a/c

(Amount-Rs.)

Previous Year	Particulars	Current Year
	Projects-Receipts	
910,000.00	FS 013 (MVS)	-
461,349.00	FS003(PJ)	608,214.00
387,500.00	FS005(NAT)	25,320.00
6,685.00	FS006(PN)	-
377,917.00	FS-007(PB)	455,060.00
6,685.00	FS-009(NN)	-
387,500.00	FS-011(SR)	611,129.00
387,500.00	FS016(DD)	367,320.00
387,500.00	FS017(AD)	456,326.00
383,333.00	FS018(PPK)	371,867.00
20,000.00	FS019(PK)	-
320,200.00	FS020(VG)	450,667.00
20,000.00	FS021(SD)	-
20,000.00	FS022(GU)	-
960,000.00	FS023 (NH)	1,117,368.00
277,395.00	FS024(RK)	420,000.00
247,338.00	FS025(PG)	420,000.00
228,400.00	FS026(SN)	759,200.00
-	FS027(KRA)	571,694.00
-	FS028(LK)	534,583.00
-	FS029(AR)	451,520.00
-	FS030(VPV)	20,000.00
-	FS031(MA)	562,020.00
-	FS032(PS)	15,793.00
-	FS033(MRP)	20,000.00
-	FS034(SM)	10,219.00
-	FS035(PJM)	20,000.00
-	FS036(KJ)	270,400.00
19,301.00	SP002	8,525.00
31,580.00	SP003	-
1,004,005.00	SP004	161,112.00
625,893.00	SP007(PS)	-
12,056.00	SP008(GKR)	-
424,327.00	SP009(SV)	-
779,230.00	SP011(PS)	-
1,396,578.00	SP013(GKR)	-
1,513,313.00	SP014(PS)	1,127,304.00
694,709.00	SP015(MS)	24,381.00
1,665,220.00	SP016 (VB)	2,418,398.00

(Amount-Rs.)

Previous Year	Particulars	Current Year
	Projects-Receipts	
1,968,439.00	SP017 (AS)	1,176,945.00
615,879.00	SP018 (SM)	17,914.00
1,456,945.00	SP019	918,394.00
1,315,335.00	SP020(AS)	1,039,070.00
634,815.00	SP022 (NRH)	1,773,832.00
254,295.00	SP023 (NRH)	396,400.00
3,551,808.00	SP024(SSM)	35,538,775.00
83,504.00	SP025 (SF)	685,850.00
49,203.00	SP026 (SS)	59,943.00
50,911.00	SP027(PS)	964,765.00
515,889.00	SP028(BD)	354,364.00
65,431.00	SP029(GKR)	1,762,023.00
4,146,793.00	SP030(SSM)	46,095.00
1,022,920.00	SP031(HBD)	735,318.00
353,869.00	SP032(NRH)	179,329.00
1,857,623.00	SP033(SSM)	1,500,000.00
1,322,862.00	SP034(SSM)	27,378.00
1,406,622.00	SP035(PS)	926,733.00
4,221,375.00	SP036(NG)	1,289,167.00
3,061,598.00	SP037(NG)	249,355.00
2,339,814.00	SP038(VB)	971,123.00
559,041.00	SP039(SF)	2,812.00
6,430,470.00	SP040(NRH)	135,506.00
872,363.00	SP041(GKR)	872,018.00
802,120.00	SP042(MS)	4,052.00
3,972,147.00	SP043(AKG)	1,405,740.00
2,333,962.00	SP044(PS)	995,976.00
1,909,289.00	SP045(ASD)	16,906.00
2,009,917.00	SP046(SF)	45,680.00
509,836.00	SP047(SG)	507,438.00
956,687.00	SP048(SG)	521,478.00
1,030,785.00	SP049(ASD)	711,421.00
-	SP050(AS)	1,190,234.00
-	SP051(RKG)	26,842,172.00
-	SP052(HBD)	2,362,653.00
-	SP053(PD)	2,510,492.00
-	SP054(VB)	1,509,676.00
-	SP055(BD)	1,839,025.00
-	SP056(SM)	1,005,731.00
-	SP057(HBD)	4,489,683.00
-	SP058(SA)	1,769,556.00
-	SP059(MS)	1,500,705.00
65,638,061.00	**TOTAL**	**113,130,147.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: D Forming part of Receipts and Payment a/c

(Amount-Rs.)

Previous Year	Particulars	Current Year
	Advances	
232,157.00	LTC [Advance]	171,543.00
208,452.00	TA India & Abroad [Advance]	41,577.00
3,285.00	Telephone [Advance]	-
941,640.00	Rent [Advance]	-
25,000.00	Office Books [Advance]	10,000.00
-	Transport maintenance [Advance]	39,000.00
-	Printing & Stationery [Advance]	35,000.00
157,523.00	Insurance [Advance]	23,906.00
348,925.00	Others [Contingencies Advance]	502,040.00
189,993.00	Others [Maintenance Advance]	357,484.00
76,400.00	Consumables, glassware and Spares [Advance]	162,498.00
15,000.00	Scientific Workshops Symposiums Seminars [Advance]	25,000.00
3,540.00	Other Research Expenses [Advance]	309,500.00
35,720.00	Lands and Buildings [Advance]	-
201,012,796.64	Equipment [Advance]	14,761,070.00
-	Major Software [Advance]	21,275.00
193,528.00	Vehicles [Advance]	85,000.00
81,272.00	Office Equipment [Advance]	86,922.00
17,009,699.00	General Deposits And Advances	758,464.00
25,000.00	EMD	-
9,000.00	Security Deposit	4,066,065.00
85,091.00	Revolving Advance	102,612.00
151,562.00	Prepaid Expenses	192,753.00
-	Leave Encashment and gratuity provision	11,000,000.00
220,805,583.64	**TOTAL**	**32,751,709.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: E Forming part of Receipts and Payment a/c

(Amount-Rs.)

Previous Year	Particulars	Current Year
	I-Remittances	
5,062,715.00	Income Tax	6,368,316.00
6,795.00	Others (I-Remittances)	7,260.00
100,100.00	Professional Tax	123,150.00
5,708,863.00	TDS	3,665,814.00
10,878,473.00	**TOTAL**	**10,164,540.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: F Forming part of Receipts and Payment a/c

(Amount-Rs.)

Previous Year	Particulars	Current Year
	Projects - Expenditure	
911,116.33	FS 013 (MVS)	76,022.67
490,850.00	FS003(PJ)	554,124.00
101,205.00	FS004	-
335,000.00	FS005(NAT)	50,320.00
6,685.00	FS006(PN)	-
337,000.00	FS-007(PB)	464,704.00
6,685.00	FS-009(NN)	-
360,000.00	FS-011(SR)	494,143.00
396,000.00	FS014(MPU)	-
421,612.00	FS015(NG)	-
360,000.00	FS016(DD)	425,398.00
333,917.00	FS017(AD)	445,613.00
379,500.00	FS018(PPK)	411,600.00
20,000.00	FS019(PK)	-
320,200.00	FS020(VG)	434,000.00
20,000.00	FS021(SD)	-
20,000.00	FS022(GU)	-
501,500.00	FS023 (NH)	1,096,558.00
277,395.00	FS024(RK)	400,000.00
247,312.00	FS025(PG)	419,876.00
228,400.00	FS026(SN)	700,800.00
-	FS027(KRA)	532,142.00
-	FS028(LK)	494,167.00
-	FS029(AR)	356,167.00
-	FS030(VPV)	8,360.00
-	FS031(MA)	481,756.00
-	FS032(PS)	15,634.00
-	FS033(MRP)	19,981.00
-	FS034(SM)	10,000.00
-	FS035(PJM)	10,000.00
-	FS036(KJ)	172,200.00
198,073.00	SP002	408,924.00
270,876.00	SP003	740,488.00
612,975.00	SP004	156,709.00
385,085.00	SP007(PS)	267,305.00
396,142.00	SP008(GKR)	832,839.00
-11,232.00	SP009(SV)	-
4,924,233.00	SP011(PS)	188,636.00
275,496.00	SP012(MS)	-
1,286,634.00	SP013(GKR)	224,761.00
1,474,590.00	SP014(PS)	886,779.00
640,343.00	SP015(MS)	666,347.00

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: F Forming part of Receipts and Payment a/c

(Amount-Rs.)

Previous Year	Particulars	Current Year
	Projects - Expenditure	
1,732,912.00	SP016 (VB)	2,226,774.00
1,681,204.00	SP017 (AS)	1,697,359.00
674,686.00	SP018 (SM)	645,254.00
1,276,422.19	SP019	1,063,063.00
899,292.00	SP020(AS)	979,472.00
1,671,346.00	SP022 (NRH)	1,181,949.00
1,197,767.00	SP023 (NRH)	452,412.00
15,924,010.42	SP024(SSM)	56,796,579.91
2,523,363.00	SP025 (SF)	872,273.00
1,598,814.00	SP026 (SS)	176,814.00
2,135,650.00	SP027(PS)	855,276.00
441,759.00	SP028(BD)	745,863.00
2,191,042.00	SP029(GKR)	1,893,804.00
585,370.00	SP030(SSM)	3,114,748.00
640,813.32	SP031(HBD)	968,336.00
294,403.00	SP032(NRH)	178,451.00
388,885.00	SP033(SSM)	2,067,299.00
271,803.00	SP034(SSM)	812,762.00
1,349,781.40	SP035(PS)	1,098,231.27
109,073.00	SP036(NG)	4,597,359.00
2,132,859.86	SP037(NG)	798,200.43
1,050,692.00	SP038(VB)	1,153,538.00
345,099.00	SP039(SF)	204,973.00
672,032.00	SP040(NRH)	3,738,995.00
718,239.00	SP041(GKR)	861,919.00
435,609.00	SP042(MS)	356,323.00
813,322.00	SP043(AKG)	2,676,780.00
813,882.09	SP044(PS)	2,178,053.91
168,414.00	SP045(ASD)	1,688,427.00
224,222.00	SP046(SF)	1,669,467.00
345,513.00	SP047(SG)	595,500.00
282,141.00	SP048(SG)	806,743.00
-	SP049(ASD)	593,195.00
-	SP050(AS)	638,451.00
-	SP051(RKG)	14,945,091.84
-	SP052(HBD)	2,015,281.00
-	SP053(PD)	1,336,932.00
-	SP054(VB)	743,897.50
-	SP055(BD)	940,799.50
-	SP056(SM)	629,494.00
-	SP057(HBD)	107,968.00
-	SP059(MS)	262,005.00
62,118,013.61	**TOTAL**	**133,812,467.03**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: G Forming part of Balance sheet

(Amount-Rs.)

Previous Year	Particulars	Current Year
4,137,330.00	March Salaries	4,432,197.00
271,883.00	NPS Employer Contribution	153,787.00
59,000.00	Audit Fee	59,000.00
1,486,912.00	Electricity Charges	1,943,500.00
-	Water Charges	282,030.00
21,830.00	Telephone Charges	21,830.00
-	Website maintenance Charges	9,794.00
-	Photo Copier maintenance Charges	26,253.00
-	Postage & Courier Charges	3,116.00
1,199,000.00	Outsourcing Contract Charges	1,631,342.00
695,500.00	Security Contract Charges	907,927.00
190,580.00	Technical maintenance Contract Charges	241,020.00
11,800.00	Biowaste maintenance Charges	5,900.00
14,750.00	Software Maintenance Charges	73,750.00
	HVAC AMC	1,023,333.00
8,088,585.00	**TOTAL**	**10,814,779.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: H Forming part of Balance sheet

(Amount-Rs.)

Previous Year	Particulars	Current Year
	LOANS AND ADVANCES	
195,188,788.86	Equipment [Advance]	7,512,070.00
85,000.00	Vehicles [Advance]	-
649,000.00	Works and Services [Advance]	-
195,922,788.86	**TOTAL**	**7,512,070.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: I Forming part of Balance sheet

(Amount-Rs.)

Previous Year	Particulars	Current Year
	PREPAYMENTS / DEPOSITS	
2,000.00	Consumables, glassware and Spares [Advance]	-
120,688.00	General Deposits And Advances	-
-	Other Research Expenses [Advance]	4,500.00
-	Others [Contingencies Advance]	33,000.00
45,000.00	Others [Maintenance Advance]	20,000.00
151,562.00	Prepaid Expenses	192,753.00
1,041,640.00	Rent [Advance]	100,000.00
192,753.00	Telephone [Advance]	-
1,553,643.00	**TOTAL**	**350,253.00**

NATIONAL INSTITUTE OF ANIMAL BIOTECHNOLOGY
For the Year Ended 31st MAR 2020

Annexure: J Forming part of Income and Expenditure statement

(Amount-Rs.)

Previous Year	Particulars	Current Year
	Provision For Salaries and other Expenses	
	Addition during the year :	
4,137,330.00	Salaries for March	4,432,197.00
271,883.00	NPS (Employer contribution)	153,787.00
59,000.00	Audit Fee	59,000.00
1,486,912.00	Electricity	1,943,500.00
-	Water charges	282,030.00
21,830.00	Telephone Charges	21,830.00
-	Website maintenance charges	9,794.00
-	Photo copier maintenance charges	26,253.00
-	Postage & Courier Charges	3,116.00
1,199,000.00	Outsourcing Contract Charges	1,631,342.00
695,500.00	Security Contract Charges	907,927.00
190,580.00	Technical maintenance Contract Charges	241,020.00
11,800.00	Biowaste maintenance Charges	5,900.00
14,750.00	Software Maintenance Charges	73,750.00
-	HVAC AMC	1,023,333.00
8,088,585.00	**Sub total**	**10,814,779.00**
3,858,197.00	Less : Adjustments during the year (Refer Annexure-G)	8,088,585.00
4,230,388.00	**TOTAL**	**2,726,194.00**

NIAB, Hyderabad
FS003 (PJ)-DST - INSPIRE Fellowship
P.I: Dr. Padmaja Jakka, DBT JRF
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
1,95,000.00	Opening Balance	1,65,499.00			0.00
4,61,349.00	Grant In Aid	6,08,214.00	4,70,850.00	Salaries - Manpower	5,46,840.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	20,000.00	Contingencies	2,000.00
0.00		0.00	0.00	Travel	5,284.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
6,56,349.00		**7,73,713.00**	**4,90,850.00**		**5,54,124.00**
0.00	Excess of Expenditure over Income	**0.00**	**1,65,499.00**	Closing Balance	**2,19,589.00**
6,56,349.00		**7,73,713.00**	**6,56,349.00**		**7,73,713.00**

NIAB, Hyderabad
FS004-DBT-JRF Programme
P.I: Dr. Hiral Mistry, DBT JRF
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
1,01,205.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	0.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	1,01,205.00	Transfer of Funds	0.00
1,01,205.00		**0.00**	**1,01,205.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**0.00**
1,01,205.00		**0.00**	**1,01,205.00**		**0.00**

NIAB, Hyderabad
FS005 (NAT)-DBT JRF
P.I: Neelam A Topno
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
33,583.00	Opening Balance	86,083.00			0.00
3,87,500.00	Grant In Aid	25,320.00	3,05,000.00	Salaries - Manpower	50,320.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	30,000.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
4,21,083.00		**1,11,403.00**	**3,35,000.00**		**50,320.00**
0.00	Excess of Expenditure over Income	**0.00**	**86,083.00**	Closing Balance	**61,083.00**
4,21,083.00		**1,11,403.00**	**4,21,083.00**		**1,11,403.00**

NIAB, Hyderabad
FS006 (PN)-CSIR JRF
P.I: PRACHITA NANDINI
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
6,685.00	Grant In Aid	0.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	6,685.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
6,685.00		**0.00**	**6,685.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**0.00**
6,685.00		**0.00**	**6,685.00**		**0.00**

NIAB, Hyderabad
FS-007 (PB)-Junior Research Fellow (RSP)
P.I: Mr. Araveti Prasanna Babu
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	22,500.00	18,417.00		0.00
3,77,917.00	Grant In Aid	4,55,060.00	3,17,000.00	Salaries - Manpower	4,44,871.00
0.00	Other Receipts	0.00	0.00	Consumables	8,179.00
0.00		0.00	20,000.00	Contingencies	5,000.00
0.00		0.00	0.00	Travel	6,654.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
3,77,917.00		**4,77,560.00**	**3,55,417.00**		**4,64,704.00**
0.00	Excess of Expenditure over Income	**0.00**	**22,500.00**	Closing Balance	**12,856.00**
3,77,917.00		**4,77,560.00**	**3,77,917.00**		**4,77,560.00**

NIAB, Hyderabad
FS-009 (NN)-CSIR-UGC Fellowship
P.I: Mr. B. Nagaraj Nayak
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
6,685.00	Grant In Aid	0.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	6,685.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
6,685.00		**0.00**	**6,685.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**0.00**
6,685.00		**0.00**	**6,685.00**		**0.00**

NIAB, Hyderabad
FS-011 (SR)-DBT-JRF Fellowship
P.I: Mr. Sonti Roy
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
32,500.00	Opening Balance	60,000.00			0.00
3,87,500.00	Grant In Aid	6,11,129.00	3,30,000.00	Salaries - Manpower	4,73,129.00
0.00	Other Receipts	0.00	0.00	Consumables	3,026.00
0.00		0.00	30,000.00	Contingencies	17,988.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
4,20,000.00		**6,71,129.00**	**3,60,000.00**		**4,94,143.00**
0.00	Excess of Expenditure over Income	**0.00**	**60,000.00**	Closing Balance	**1,76,986.00**
4,20,000.00		**6,71,129.00**	**4,20,000.00**		**6,71,129.00**

NIAB, Hyderabad
FS 013 (MVS)-SERB - Post Doctoral Fellowship
P.I: Dr. Muthu Varunan Shalu
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
77,139.00	Opening Balance	76,022.67			
9,10,000.00	Grant In Aid	0.00	6,60,000.00	Salaries - Manpower	73,333.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	50,000.00	Overheads	0.00
0.00		0.00	2,01,116.33	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	2,689.67
9,87,139.00		**76,022.67**	**9,11,116.33**		**76,022.67**
0.00	Excess of Expenditure over Income	**0.00**	**76,022.67**	Closing Balance	**0.00**
9,87,139.00		**76,022.67**	**9,87,139.00**		**76,022.67**

NIAB, Hyderabad
FS014 (MPU)-SERB - NPDF
P.I: MEENAL P ULLEWAR
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
3,96,000.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	0.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	3,96,000.00	Transfer of Funds	0.00
3,96,000.00		**0.00**	**3,96,000.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**0.00**
3,96,000.00		**0.00**	**3,96,000.00**		**0.00**

NIAB, Hyderabad
FS015 (NG)-ICMR SENIOR RESEARCH FELLOW
P.I: Ms. Nilanjana Ganguli
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
4,21,612.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	0.00	3,15,187.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	1,06,425.00	Transfer of Funds	0.00
4,21,612.00		**0.00**	**4,21,612.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**0.00**
4,21,612.00		**0.00**	**4,21,612.00**		**0.00**

NIAB, Hyderabad
FS016(DD)-DBT JRF
P.I: Mr Debabrata Dandasena
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
32,499.00	Opening Balance	59,999.00			0.00
3,87,500.00	Grant In Aid	3,67,320.00	3,30,000.00	Salaries - Manpower	3,97,320.00
0.00	Other Receipts	0.00	0.00	Consumables	6,278.00
0.00		0.00	30,000.00	Contingencies	21,800.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
4,19,999.00		**4,27,319.00**	**3,60,000.00**		**4,25,398.00**
0.00	Excess of Expenditure over Income	**0.00**	**59,999.00**	Closing Balance	**1,921.00**
4,19,999.00		**4,27,319.00**	**4,19,999.00**		**4,27,319.00**

NIAB, Hyderabad
FS017 (AD)-DBT JRF
P.I: Mr Abhishek Das
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
32,605.00	Opening Balance	86,188.00			0.00
3,87,500.00	Grant In Aid	4,56,326.00	3,03,917.00	Salaries - Manpower	4,22,320.00
0.00	Other Receipts	0.00	0.00	Consumables	13,293.00
0.00		0.00	30,000.00	Contingencies	10,000.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
4,20,105.00		**5,42,514.00**	**3,33,917.00**		**4,45,613.00**
0.00	Excess of Expenditure over Income	**0.00**	**86,188.00**	Closing Balance	**96,901.00**
4,20,105.00		**5,42,514.00**	**4,20,105.00**		**5,42,514.00**

NIAB, Hyderabad
FS018 (PPK)-DST INSPIRE Fellowship
P.I: Ms Prajna Parimita Kar
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
1,06,167.00	Opening Balance	1,10,000.00			0.00
3,83,333.00	Grant In Aid	3,71,867.00	3,43,000.00	Salaries - Manpower	3,91,600.00
0.00	Other Receipts	0.00	0.00	Consumables	301.00
0.00		0.00	36,500.00	Contingencies	13,045.00
0.00		0.00	0.00	Travel	6,654.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
4,89,500.00		**4,81,867.00**	**3,79,500.00**		**4,11,600.00**
0.00	Excess of Expenditure over Income	**0.00**	**1,10,000.00**	Closing Balance	**70,267.00**
4,89,500.00		**4,81,867.00**	**4,89,500.00**		**4,81,867.00**

NIAB, Hyderabad
FS019 (PK)-CSIR Project
P.I: Pankaj Kumar
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
20,000.00	Grant In Aid	0.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	20,000.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
20,000.00		**0.00**	**20,000.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**0.00**
20,000.00		**0.00**	**20,000.00**		**0.00**

NIAB, Hyderabad
FS020(VG)-Generation of recombinant therapeutics in animal bioreactors for increasing affordability and improvement of human health.
P.I: Mr.VENKATESWARAN GANESAN
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
3,20,200.00	Grant In Aid	4,50,667.00	3,05,200.00	Salaries - Manpower	4,34,000.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	15,000.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
3,20,200.00		**4,50,667.00**	**3,20,200.00**		**4,34,000.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**16,667.00**
3,20,200.00		**4,50,667.00**	**3,20,200.00**		**4,50,667.00**

NIAB, Hyderabad
FS021(SD)-CSIR-UGC
P.I: SUNNY DEVAL
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
20,000.00	Grant In Aid	0.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	20,000.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
20,000.00		**0.00**	**20,000.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**0.00**
20,000.00		**0.00**	**20,000.00**		**0.00**

NIAB, Hyderabad
FS022(GU)-CSIR
P.I: GOUTAM ULGEKAR
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
20,000.00	Grant In Aid	0.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	20,000.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
20,000.00		**0.00**	**20,000.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**0.00**
20,000.00		**0.00**	**20,000.00**		**0.00**

NIAB, Hyderabad
FS023 (NH)-SERB
P.I: Dr.Neelima Hosamani
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	4,58,500.00			0.00
9,60,000.00	Grant In Aid	11,17,368.00	4,01,500.00	Salaries - Manpower	8,05,200.00
0.00	Other Receipts	0.00	0.00	Consumables	1,66,034.00
0.00		0.00	0.00	Contingencies	2,256.00
0.00		0.00	0.00	Travel	5,549.00
0.00		0.00	1,00,000.00	Overheads	50,000.00
0.00		0.00	0.00	Equipment	67,519.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
9,60,000.00		**15,75,868.00**	**5,01,500.00**		**10,96,558.00**
0.00	Excess of Expenditure over Income	**0.00**	**4,58,500.00**	Closing Balance	**4,79,310.00**
9,60,000.00		**15,75,868.00**	**9,60,000.00**		**15,75,868.00**

NIAB, Hyderabad
FS024 (RK)-DBT-JRF
P.I: Mr. Rishi Kumar
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
2,77,395.00	Grant In Aid	4,20,000.00	2,52,645.00	Salaries - Manpower	3,90,000.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	24,750.00	Contingencies	10,000.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
2,77,395.00		**4,20,000.00**	**2,77,395.00**		**4,00,000.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**20,000.00**
2,77,395.00		**4,20,000.00**	**2,77,395.00**		**4,20,000.00**

NIAB, Hyderabad
FS025 (PG)-DBT-JRF
P.I: Ms. Priya Gupta
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	26.00			0.00
2,47,338.00	Grant In Aid	4,20,000.00	2,24,893.00	Salaries - Manpower	3,90,000.00
0.00	Other Receipts	0.00	0.00	Consumables	19,876.00
0.00		0.00	22,419.00	Contingencies	10,000.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
2,47,338.00		**4,20,026.00**	**2,47,312.00**		**4,19,876.00**
0.00	Excess of Expenditure over Income	**0.00**	**26.00**	Closing Balance	**150.00**
2,47,338.00		**4,20,026.00**	**2,47,338.00**		**4,20,026.00**

NIAB, Hyderabad
FS026 (SN)-ICMR
P.I: SWAPNA N
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
2,28,400.00	Grant In Aid	7,59,200.00	2,18,400.00	Salaries - Manpower	6,95,800.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	10,000.00	Contingencies	5,000.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
2,28,400.00		**7,59,200.00**	**2,28,400.00**		**7,00,800.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**58,400.00**
2,28,400.00		**7,59,200.00**	**2,28,400.00**		**7,59,200.00**

NIAB, Hyderabad
FS027 (KRA)-DBT- JRF
P.I: Ms. Kalyani Rajendra Aswale
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	5,71,694.00	0.00	Salaries - Manpower	5,27,903.00
0.00	Other Receipts	0.00	0.00	Consumables	4,239.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**5,71,694.00**	**0.00**		**5,32,142.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**39,552.00**
0.00		**5,71,694.00**	**0.00**		**5,71,694.00**

NIAB, Hyderabad
FS028 (LK)-DBT-JRF
P.I: Mr.Lava Kumar
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	5,34,583.00	0.00	Salaries - Manpower	4,94,167.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**5,34,583.00**	**0.00**		**4,94,167.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**40,416.00**
0.00		**5,34,583.00**	**0.00**		**5,34,583.00**

NIAB, Hyderabad
FS029 (AR)-DST-INSPIRE FELLOWSHIP
P.I: Akanksha Roberts
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	4,51,520.00	0.00	Salaries - Manpower	3,46,167.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	10,000.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**4,51,520.00**	**0.00**		**3,56,167.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**95,353.00**
0.00		**4,51,520.00**	**0.00**		**4,51,520.00**

NIAB, Hyderabad
FS030 (VPV)-CSIR - Fellowship
P.I: D Vivek Phani Varma
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	20,000.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	8,360.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**20,000.00**	**0.00**		**8,360.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**11,640.00**
0.00		**20,000.00**	**0.00**		**20,000.00**

NIAB, Hyderabad
FS031 (MA)-DBT-Research Associate-I
P.I: Dr. Madhavi Annamanedi
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	5,62,020.00	0.00	Salaries - Manpower	4,66,240.00
0.00	Other Receipts	0.00	0.00	Consumables	15,516.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**5,62,020.00**	**0.00**		**4,81,756.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**80,264.00**
0.00		**5,62,020.00**	**0.00**		**5,62,020.00**

NIAB, Hyderabad
FS032 (PS)-CSIR - Fellowship
P.I: Ms. Prerna Saini
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	15,793.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	5,634.00
0.00		0.00	0.00	Contingencies	10,000.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**15,793.00**	**0.00**		**15,634.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**159.00**
0.00		**15,793.00**	**0.00**		**15,793.00**

NIAB, Hyderabad
FS033 (MRP)-CSIR - Fellowship
P.I: Mr. Manas Ranjan Praharaj
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	20,000.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	19,981.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**20,000.00**	**0.00**		**19,981.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**19.00**
0.00		**20,000.00**	**0.00**		**20,000.00**

NIAB, Hyderabad
FS034 (SM)-CSIR - Fellowship
P.I: Mr. Subhasis Mahari
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	10,219.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	10,000.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**10,219.00**	**0.00**		**10,000.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**219.00**
0.00		**10,219.00**	**0.00**		**10,219.00**

NIAB, Hyderabad
FS035(PJM)-CSIR - Fellowship
P.I:Ms. Pagala Jasmeen
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	20,000.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	10,000.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**20,000.00**	**0.00**		**10,000.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**10,000.00**
0.00		**20,000.00**	**0.00**		**20,000.00**

NIAB, Hyderabad
FS036(KJ)-Identification and characterization of novel host targets for developing improved therapeutics for the zoonotic disease, Brucellosis.
P.I: Mrs.Kiranmai Joshi
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	2,70,400.00	0.00	Salaries - Manpower	1,72,200.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**2,70,400.00**	**0.00**		**1,72,200.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**98,200.00**
0.00		**2,70,400.00**	**0.00**		**2,70,400.00**

NIAB, Hyderabad
SP002-Characterization of Cell Cycle regulators associated with DNA replication machinery in Toxoplasma Gondii - DST INSPIRE Faculty
P.I: Dr. Abhijit S Deshmukh
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
6,56,675.50	Opening Balance	4,77,903.50			0.00
0.00	Grant In Aid	0.00	1,49,480.00	Salaries - Manpower	0.00
19,301.00	Other Receipts	8,525.00	7,118.00	Consumables	3,12,924.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	6,475.00	Travel	0.00
0.00		0.00	35,000.00	Overheads	0.00
0.00		0.00	0.00	Equipment	96,000.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
6,75,976.50		**4,86,428.50**	**1,98,073.00**		**4,08,924.00**
0.00	Excess of Expenditure over Income	**0.00**	**4,77,903.50**	Closing Balance	**77,504.50**
6,75,976.50		**4,86,428.50**	**6,75,976.50**		**4,86,428.50**

NIAB, Hyderabad
SP003-Understanding the host response and molecular pathogenesis of Leptospira interrogans infection - Ramalingaswamy Fellowship
P.I: Dr. Syed Faisal
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
9,79,784.00	Opening Balance	7,40,488.00			0.00
0.00	Grant In Aid	0.00	74,100.00	Salaries - Manpower	0.00
31,580.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	1,96,776.00	Equipment	2,28,225.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	5,12,263.00
10,11,364.00		**7,40,488.00**	**2,70,876.00**		**7,40,488.00**
0.00	Excess of Expenditure over Income	**0.00**	**7,40,488.00**	Closing Balance	**0.00**
10,11,364.00		**7,40,488.00**	**10,11,364.00**		**7,40,488.00**

NIAB, Hyderabad
SP004-Evaluation of Anti-inflammatory Natural Compounds for Therapeutic use in Mastitis of Dairy Animals - NMPB
P.I:Prof P Reddanna & Dr. Paresh Sharma
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	1,24,514.00	2,66,516.00		0.00
10,00,000.00	Grant In Aid	1,56,709.00	1,22,133.00	Salaries - Manpower	1,56,709.00
4,005.00	Other Receipts	4,403.00	4,00,105.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	22,237.00	Travel	0.00
0.00		0.00	68,500.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
10,04,005.00		**2,85,626.00**	**8,79,491.00**		**1,56,709.00**
0.00	Excess of Expenditure over Income	**0.00**	**1,24,514.00**	Closing Balance	**1,28,917.00**
10,04,005.00		**2,85,626.00**	**10,04,005.00**		**2,85,626.00**

NIAB, Hyderabad
SP005-Role of gamma delta T cells in inflammation - DST Women Scientist Scheme
P.I:Dr. Aparna Rachamallu
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00	62,034.00	Opening Balance	62,034.00
0.00	Grant In Aid	0.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**0.00**	**62,034.00**		**62,034.00**
62,034.00	Excess of Expenditure over Income	**62,034.00**	**0.00**	Closing Balance	**0.00**
62,034.00		**62,034.00**	**62,034.00**		**62,034.00**

NIAB, Hyderabad
SP007(PS)-Identification of disease related markers for the diagnosis of Subclinical Mastitis
P.I: Dr. Paresh Sharma
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
26,497.00	Opening Balance	2,67,305.00			0.00
6,15,486.00	Grant In Aid	0.00	78,000.00	Salaries - Manpower	0.00
10,407.00	Other Receipts	0.00	3,02,595.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	4,490.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	2,67,305.00
6,52,390.00		**2,67,305.00**	**3,85,085.00**		**2,67,305.00**
0.00	Excess of Expenditure over Income	**0.00**	**2,67,305.00**	Closing Balance	**0.00**
6,52,390.00		**2,67,305.00**	**6,52,390.00**		**2,67,305.00**

NIAB, Hyderabad
SP008(GKR)-Understanding the immune mechanism of host disease and development of marker vaccines and DIVA test for Peste des Petits ruminants
P.I: Dr.Girish K Radhakrishnan
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
12,16,925.00	Opening Balance	8,32,839.00			0.00
0.00	Grant In Aid	0.00	52,250.00	Salaries - Manpower	0.00
12,056.00	Other Receipts	0.00	3,40,417.00	Consumables	0.00
0.00		0.00	1,111.00	Contingencies	0.00
0.00		0.00	2,364.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	8,32,839.00
12,28,981.00		**8,32,839.00**	**3,96,142.00**		**8,32,839.00**
0.00	Excess of Expenditure over Income	**0.00**	**8,32,839.00**	Closing Balance	**0.00**
12,28,981.00		**8,32,839.00**	**12,28,981.00**		**8,32,839.00**

NIAB, Hyderabad
SP009(SV)-Effect of Kisspeptin on endocrine profile and follicular dynamics in buffaloes
P.I: Dr. Satya Velmurugan
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00	4,35,559.00		0.00
4,24,327.00	Grant In Aid	0.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	- 11,232.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
4,24,327.00		**0.00**	**4,24,327.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**0.00**
4,24,327.00		**0.00**	**4,24,327.00**		**0.00**

NIAB, Hyderabad
SP011(PS)-Genome-wide association study for identification of novel loci associated with resistance to Theileriosis in India
P.I: Dr. Paresh Sharma
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
43,33,639.00	Opening Balance	1,88,636.00			0.00
6,32,141.00	Grant In Aid	0.00	3,60,361.00	Salaries - Manpower	0.00
1,47,089.00	Other Receipts	0.00	45,44,913.00	Consumables	0.00
0.00		0.00	5,815.00	Contingencies	0.00
0.00		0.00	13,144.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	1,88,636.00
51,12,869.00		**1,88,636.00**	**49,24,233.00**		**1,88,636.00**
0.00	Excess of Expenditure over Income	**0.00**	**1,88,636.00**	Closing Balance	**0.00**
51,12,869.00		**1,88,636.00**	**51,12,869.00**		**1,88,636.00**

NIAB, Hyderabad
SP012(MS)-Elucidation of the role of nonstructural (W) protein of Avian Paramyxoviruses
P.I: Dr.Madhuri Subbiah
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
2,75,496.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	0.00	75,400.00	Salaries - Manpower	0.00
0.00	Other Receipts	0.00	1,26,798.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	73,298.00	Transfer of Funds	0.00
2,75,496.00		**0.00**	**2,75,496.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**0.00**
2,75,496.00		**0.00**	**2,75,496.00**		**0.00**

NIAB, Hyderabad
SP013(GKR)-To develop novel therapeutics for brucellosis: Identification and characterization of host factors supporting Brucella replication
P.I: Dr. Girish K Radhakrishnan
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
1,14,817.00	Opening Balance	2,24,761.00			0.00
13,73,415.00	Grant In Aid	0.00	2,05,400.00	Salaries - Manpower	70,980.00
23,163.00	Other Receipts	0.00	10,77,842.00	Consumables	0.00
0.00		0.00	3,392.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	1,53,781.00
15,11,395.00		**2,24,761.00**	**12,86,634.00**		**2,24,761.00**
0.00	Excess of Expenditure over Income	**0.00**	**2,24,761.00**	Closing Balance	**0.00**
15,11,395.00		**2,24,761.00**	**15,11,395.00**		**2,24,761.00**

NIAB, Hyderabad
SP014(PS)-Identification of Virulence factors associated with Theileria annulata infection in Indian Cattle
P.I: Dr. Paresh Sharma
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
11,017.00	Opening Balance	49,740.00			0.00
14,86,867.00	Grant In Aid	11,09,453.00	3,55,640.00	Salaries - Manpower	2,27,787.00
26,446.00	Other Receipts	17,851.00	10,74,408.00	Consumables	6,36,152.00
0.00		0.00	4,542.00	Contingencies	22,840.00
0.00		0.00	40,000.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
15,24,330.00		**11,77,044.00**	**14,74,590.00**		**8,86,779.00**
0.00	Excess of Expenditure over Income	**0.00**	**49,740.00**	Closing Balance	**2,90,265.00**
15,24,330.00		**11,77,044.00**	**15,24,330.00**		**11,77,044.00**

NIAB, Hyderabad

SP015(MS)-A Study to Understand the genetic variations among the field isolates of porcine circo viruses from piggery farms in Mizoram, with ultimate aim to engineer an effective recombinant chimeric DIVA vaccine

P.I: Dr. Madhuri Subbiah

Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
9,53,097.00	Opening Balance	10,07,463.00			0.00
6,68,000.00	Grant In Aid	0.00	1,37,600.00	Salaries - Manpower	1,44,000.00
26,709.00	Other Receipts	24,381.00	4,98,925.00	Consumables	4,74,248.00
0.00		0.00	3,818.00	Contingencies	9,377.00
0.00		0.00	0.00	Travel	38,722.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
16,47,806.00		**10,31,844.00**	**6,40,343.00**		**6,66,347.00**
0.00	Excess of Expenditure over Income	**0.00**	**10,07,463.00**	Closing Balance	**3,65,497.00**
16,47,806.00		**10,31,844.00**	**16,47,806.00**		**10,31,844.00**

NIAB, Hyderabad

SP016 (VB)-DST INSPIRE FACULTY-Charterization of transglycosylases associated with cell wall biogenesis in Vancomycin resistant Staphylococcus aureus

P.I: Dr. Vasundhra Bhandari

Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
82,706.00	Opening Balance	15,014.00			0.00
16,41,698.00	Grant In Aid	24,01,067.00	11,03,160.00	Salaries - Manpower	19,24,779.00
23,522.00	Other Receipts	17,331.00	5,35,396.00	Consumables	2,66,995.00
0.00		0.00	22,482.00	Contingencies	0.00
0.00		0.00	36,874.00	Travel	0.00
0.00		0.00	35,000.00	Overheads	35,000.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
17,47,926.00		**24,33,412.00**	**17,32,912.00**		**22,26,774.00**
0.00	Excess of Expenditure over Income	**0.00**	**15,014.00**	Closing Balance	**2,06,638.00**
17,47,926.00		**24,33,412.00**	**17,47,926.00**		**24,33,412.00**

NIAB, Hyderabad
SP017 (AS)-Elucidation of mechanism(s) of transformation of host cells by Theileria annulata
P.I: Dr. Anand Srivastava
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
3,41,576.00	Opening Balance	6,28,811.00			0.00
19,50,000.00	Grant In Aid	11,50,000.00	4,13,400.00	Salaries - Manpower	5,38,955.00
18,439.00	Other Receipts	26,945.00	10,95,877.00	Consumables	9,56,572.00
0.00		0.00	8,310.00	Contingencies	6,500.00
0.00		0.00	0.00	Travel	41,559.00
0.00		0.00	1,50,000.00	Overheads	1,50,000.00
0.00		0.00	13,617.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	3,773.00
23,10,015.00		**18,05,756.00**	**16,81,204.00**		**16,97,359.00**
0.00	Excess of Expenditure over Income	**0.00**	**6,28,811.00**	Closing Balance	**1,08,397.00**
23,10,015.00		**18,05,756.00**	**23,10,015.00**		**18,05,756.00**

NIAB, Hyderabad
SP018 (SM)-Towards establishing an efficient animal-based production of thrapeutic Protein in Milk of farmed animals using various modes of gene delivery
P.I: Dr. Subeer S Majumdar
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
9,46,845.00	Opening Balance	8,88,038.00			0.00
5,97,278.00	Grant In Aid	0.00	45,240.00	Salaries - Manpower	0.00
18,601.00	Other Receipts	17,914.00	5,67,436.00	Consumables	6,19,490.00
0.00		0.00	15,909.00	Contingencies	8,455.00
0.00		0.00	46,101.00	Travel	17,309.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
15,62,724.00		**9,05,952.00**	**6,74,686.00**		**6,45,254.00**
0.00	Excess of Expenditure over Income	**0.00**	**8,88,038.00**	Closing Balance	**2,60,698.00**
15,62,724.00		**9,05,952.00**	**15,62,724.00**		**9,05,952.00**

NIAB, Hyderabad
SP019-Development of peptide based anti-inflammatory drug for septicemia
P.I: Dr. Girish K Radhakrishnan
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
5,54,522.15	Opening Balance	7,35,044.96			0.00
14,33,000.00	Grant In Aid	9,00,000.00	1,72,440.00	Salaries - Manpower	3,12,841.00
23,945.00	Other Receipts	18,394.00	5,96,072.00	Consumables	5,79,211.00
0.00		0.00	33,051.19	Contingencies	39,488.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	1,47,000.00	Overheads	1,06,400.00
0.00		0.00	1,72,013.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	1,55,846.00	Transfer of Funds	25,123.00
20,11,467.15		**16,53,438.96**	**12,76,422.19**		**10,63,063.00**
0.00	Excess of Expenditure over Income	**0.00**	**7,35,044.96**	Closing Balance	**5,90,375.96**
20,11,467.15		**16,53,438.96**	**20,11,467.15**		**16,53,438.96**

NIAB, Hyderabad
SP020(AS)-Evaluation of medicinal plant extracts for anti-tick activity and identification of active compounds
P.I: Dr. Anand Srivastava
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
2,32,683.00	Opening Balance	6,48,726.00			0.00
13,00,000.00	Grant In Aid	10,38,480.00	3,66,254.00	Salaries - Manpower	2,25,000.00
15,335.00	Other Receipts	590.00	2,86,757.00	Consumables	4,65,152.00
0.00		0.00	29,370.00	Contingencies	41,466.00
0.00		0.00	70,550.00	Travel	12,622.00
0.00		0.00	90,000.00	Overheads	92,280.00
0.00		0.00	- 21,426.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	77,787.00	Transfer of Funds	1,42,952.00
15,48,018.00		**16,87,796.00**	**8,99,292.00**		**9,79,472.00**
0.00	Excess of Expenditure over Income	**0.00**	**6,48,726.00**	Closing Balance	**7,08,324.00**
15,48,018.00		**16,87,796.00**	**15,48,018.00**		**16,87,796.00**

NIAB, Hyderabad
SP022 (NRH)-Development, testing and evaluation of whole and recombinant antigen-based ELISA for monitoring the health of laboratory animals Phase -II
P.I: Dr. Nagendra R Hegde
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
11,72,313.00	Opening Balance	1,35,782.00			0.00
6,14,487.00	Grant In Aid	17,53,908.00	7,36,400.00	Salaries - Manpower	9,68,932.00
20,328.00	Other Receipts	19,924.00	9,34,946.00	Consumables	2,03,475.00
0.00		0.00	0.00	Contingencies	520.00
0.00		0.00	0.00	Travel	9,022.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
18,07,128.00		**19,09,614.00**	**16,71,346.00**		**11,81,949.00**
0.00	Excess of Expenditure over Income	**0.00**	**1,35,782.00**	Closing Balance	**7,27,665.00**
18,07,128.00		**19,09,614.00**	**18,07,128.00**		**19,09,614.00**

NIAB, Hyderabad
SP023 (NRH)-Molecular epidemiology and genomics of mastitis-associated staphylococci
P.I: Dr. Nagendra R Hegde
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
9,99,484.00	Opening Balance	56,012.00			0.00
2,35,916.00	Grant In Aid	3,96,400.00	5,11,680.00	Salaries - Manpower	2,34,000.00
18,379.00	Other Receipts	0.00	6,64,831.00	Consumables	91,224.00
0.00		0.00	280.00	Contingencies	23,587.00
0.00		0.00	20,976.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	1,03,601.00
12,53,779.00		**4,52,412.00**	**11,97,767.00**		**4,52,412.00**
0.00	Excess of Expenditure over Income	**0.00**	**56,012.00**	Closing Balance	**0.00**
12,53,779.00		**4,52,412.00**	**12,53,779.00**		**4,52,412.00**

NIAB, Hyderabad
SP024(SSM)-Genomics for conservation of indigenous cattle breeds and for enhancing milk yield, Phase-I
P.I: Dr. Subeer S Majumdar
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
10,48,25,041.00	Opening Balance	9,24,52,838.58			0.00
0.00	Grant In Aid	3,34,94,169.00	23,82,717.00	Salaries - Manpower	24,47,548.00
35,51,808.00	Other Receipts	20,44,606.00	19,04,900.00	Consumables	1,75,33,068.00
0.00		0.00	3,31,252.00	Contingencies	10,24,431.00
0.00		0.00	16,03,488.00	Travel	12,09,009.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	97,01,653.42	Equipment	3,45,82,523.91
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
10,83,76,849.00		**12,79,91,613.58**	**1,59,24,010.42**		**5,67,96,579.91**
0.00	Excess of Expenditure over Income	**0.00**	**9,24,52,838.58**	Closing Balance	**7,11,95,033.67**
10,83,76,849.00		**12,79,91,613.58**	**10,83,76,849.00**		**12,79,91,613.58**

NIAB, Hyderabad
SP025 (SF)-Random and Targeted mutagenesis of zoonotic pathogen Leptospira interrogans: In perspective of vaccine development
P.I: Dr. Syed Mohd Faisal
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
29,06,318.00	Opening Balance	4,66,459.00			0.00
0.00	Grant In Aid	6,69,315.00	2,10,032.00	Salaries - Manpower	72,800.00
83,504.00	Other Receipts	16,535.00	7,58,758.00	Consumables	6,83,610.00
0.00		0.00	0.00	Contingencies	10,827.00
0.00		0.00	49,617.00	Travel	20,210.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	15,04,956.00	Equipment	84,826.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
29,89,822.00		**11,52,309.00**	**25,23,363.00**		**8,72,273.00**
0.00	Excess of Expenditure over Income	**0.00**	**4,66,459.00**	Closing Balance	**2,80,036.00**
29,89,822.00		**11,52,309.00**	**29,89,822.00**		**11,52,309.00**

NIAB, Hyderabad
SP026 (SS)-Integrated Biotechnological Approach towards Improvement of Quality and Productivity of Tropical Tasar Silk
Co P.I: Dr. Shailesh Sharma
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
20,40,420.00	Opening Balance	4,90,809.00			0.00
0.00	Grant In Aid	44,000.00	82,750.00	Salaries - Manpower	1,53,194.00
49,203.00	Other Receipts	15,943.00	0.00	Consumables	0.00
0.00		0.00	6,980.00	Contingencies	3,620.00
0.00		0.00	41,604.00	Travel	0.00
0.00		0.00	0.00	Overheads	20,000.00
0.00		0.00	14,67,480.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
20,89,623.00		**5,50,752.00**	**15,98,814.00**		**1,76,814.00**
0.00	Excess of Expenditure over Income	**0.00**	**4,90,809.00**	Closing Balance	**3,73,938.00**
20,89,623.00		**5,50,752.00**	**20,89,623.00**		**5,50,752.00**

NIAB, Hyderabad
SP027(PS)-Aptamer based lateral flow device for the detection of heat or estrous in buffalo
P.I: Dr.Pankaj Suman
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
24,10,141.00	Opening Balance	3,25,402.00			0.00
0.00	Grant In Aid	9,40,520.00	1,63,600.00	Salaries - Manpower	2,20,000.00
50,911.00	Other Receipts	24,245.00	8,64,325.00	Consumables	5,42,743.00
0.00		0.00	18,437.00	Contingencies	47,748.00
0.00		0.00	15,135.00	Travel	44,785.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	10,74,153.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
24,61,052.00		**12,90,167.00**	**21,35,650.00**		**8,55,276.00**
0.00	Excess of Expenditure over Income	**0.00**	**3,25,402.00**	Closing Balance	**4,34,891.00**
24,61,052.00		**12,90,167.00**	**24,61,052.00**		**12,90,167.00**

NIAB, Hyderabad
SP028(BD)-The Ramanujan Fellowship
P.I: Dr. Bappaditya Dey, Sci-E
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
3,41,565.00	Opening Balance	4,15,695.00			0.00
5,00,000.00	Grant In Aid	3,45,000.00	0.00	Salaries - Manpower	0.00
15,889.00	Other Receipts	9,364.00	3,43,168.00	Consumables	2,53,579.00
0.00		0.00	13,814.00	Contingencies	2,473.00
0.00		0.00	24,777.00	Travel	0.00
0.00		0.00	60,000.00	Overheads	0.00
0.00		0.00	0.00	Equipment	4,89,811.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
8,57,454.00		**7,70,059.00**	**4,41,759.00**		**7,45,863.00**
0.00	Excess of Expenditure over Income	**0.00**	**4,15,695.00**	Closing Balance	**24,196.00**
8,57,454.00		**7,70,059.00**	**8,57,454.00**		**7,70,059.00**

NIAB, Hyderabad
SP029(GKR)-To understand the role of Cytoplasmic linker protien-170 in the down-regulation of TLR4 signaling
P.I: Dr.Girish K Radhakrishnan, Scintist-E
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
25,12,763.00	Opening Balance	3,87,152.00			0.00
0.00	Grant In Aid	17,27,548.00	2,60,867.00	Salaries - Manpower	4,34,000.00
65,431.00	Other Receipts	34,475.00	14,22,573.00	Consumables	13,35,583.00
0.00		0.00	7,602.00	Contingencies	6,190.00
0.00		0.00	0.00	Travel	18,031.00
0.00		0.00	1,00,000.00	Overheads	1,00,000.00
0.00		0.00	4,00,000.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
25,78,194.00		**21,49,175.00**	**21,91,042.00**		**18,93,804.00**
0.00	Excess of Expenditure over Income	**0.00**	**3,87,152.00**	Closing Balance	**2,55,371.00**
25,78,194.00		**21,49,175.00**	**25,78,194.00**		**21,49,175.00**

NIAB, Hyderabad
SP030(SSM)-Genome ending for generating semen favoring production of cow.
P.I: Dr.Subeer S Majumdar
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	35,61,423.00			0.00
40,10,000.00	Grant In Aid	0.00	83,200.00	Salaries - Manpower	2,20,000.00
1,36,793.00	Other Receipts	46,095.00	4,69,536.00	Consumables	5,66,362.00
0.00		0.00	5,400.00	Contingencies	12,058.00
0.00		0.00	27,234.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	23,16,328.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
41,46,793.00		**36,07,518.00**	**5,85,370.00**		**31,14,748.00**
0.00	Excess of Expenditure over Income	**0.00**	**35,61,423.00**	Closing Balance	**4,92,770.00**
41,46,793.00		**36,07,518.00**	**41,46,793.00**		**36,07,518.00**

NIAB, Hyderabad
SP031(HBD)-"Unraveling Molecular Mechanisms of Homologues recombination and Germ cell maintenance to prevent Birth Defects, Extend Human and livestock Fertility"
P.I: Dr.HBD Prasad Rao
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	3,82,106.68			0.00
10,00,000.00	Grant In Aid	7,27,080.00	1,90,000.00	Salaries - Manpower	5,84,655.00
22,920.00	Other Receipts	8,238.00	4,22,639.00	Consumables	3,33,939.00
0.00		0.00	18,947.32	Contingencies	36,231.00
0.00		0.00	0.00	Travel	13,511.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	9,227.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
10,22,920.00		**11,17,424.68**	**6,40,813.32**		**9,68,336.00**
0.00	Excess of Expenditure over Income	**0.00**	**3,82,106.68**	Closing Balance	**1,49,088.68**
10,22,920.00		**11,17,424.68**	**10,22,920.00**		**11,17,424.68**

NIAB, Hyderabad
SP032(NRH)-"DBT-GADVASU Canine Research Centre and Networks"
P.I: Dr.Nagendra R Hegde.
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	59,466.00			0.00
3,45,000.00	Grant In Aid	1,76,131.00	0.00	Salaries - Manpower	0.00
8,869.00	Other Receipts	3,198.00	2,69,403.00	Consumables	1,35,832.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	17,619.00
0.00		0.00	25,000.00	Overheads	25,000.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
3,53,869.00		**2,38,795.00**	**2,94,403.00**		**1,78,451.00**
0.00	Excess of Expenditure over Income	**0.00**	**59,466.00**	Closing Balance	**60,344.00**
3,53,869.00		**2,38,795.00**	**3,53,869.00**		**2,38,795.00**

NIAB, Hyderabad
SP033(SSM)-JC Bose National Fellowship
P.I: Dr.Subeer S Majumdar
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	14,68,738.00			0.00
18,11,312.00	Grant In Aid	15,00,000.00	2,63,707.00	Salaries - Manpower	6,52,969.00
46,311.00	Other Receipts	0.00	0.00	Consumables	0.00
0.00		0.00	12,000.00	Contingencies	3,150.00
0.00		0.00	13,178.00	Travel	52,403.00
0.00		0.00	1,00,000.00	Overheads	1,00,000.00
0.00		0.00	0.00	Equipment	12,58,777.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
18,57,623.00		**29,68,738.00**	**3,88,885.00**		**20,67,299.00**
0.00	Excess of Expenditure over Income	**0.00**	**14,68,738.00**	Closing Balance	**9,01,439.00**
18,57,623.00		**29,68,738.00**	**18,57,623.00**		**29,68,738.00**

NIAB, Hyderabad
SP034(SSM)-"An attempt to generate transgenic pig through testicular transgenesis or male germ cell transplantation to enhance productivity"
P.I: Dr.Subeer S Majumdar
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	10,51,059.00			0.00
12,90,000.00	Grant In Aid	0.00	83,200.00	Salaries - Manpower	1,43,200.00
32,862.00	Other Receipts	27,378.00	1,88,603.00	Consumables	1,73,494.00
0.00		0.00	0.00	Contingencies	8,260.00
0.00		0.00	0.00	Travel	61,290.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	4,26,518.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
13,22,862.00		**10,78,437.00**	**2,71,803.00**		**8,12,762.00**
0.00	Excess of Expenditure over Income	**0.00**	**10,51,059.00**	Closing Balance	**2,65,675.00**
13,22,862.00		**10,78,437.00**	**13,22,862.00**		**10,78,437.00**

NIAB, Hyderabad
SP035(PS)-"Development of point -of-care diagnostics for detection of venom proteins of Naja Naja Cobra and Bungarus caeruleus Krait in envenomed animals"
P.I: Pankaj Suman
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	56,840.60			0.00
13,84,500.00	Grant In Aid	9,23,000.00	3,77,588.00	Salaries - Manpower	6,47,996.00
22,122.00	Other Receipts	3,733.00	4,45,662.00	Consumables	3,97,938.00
0.00		0.00	1,500.00	Contingencies	41,150.00
0.00		0.00	20,634.00	Travel	26,693.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	5,04,397.40	Equipment	- 15,545.73
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
14,06,622.00		**9,83,573.60**	**13,49,781.40**		**10,98,231.27**
0.00	Excess of Expenditure over Income	**1,14,657.67**	**56,840.60**	Closing Balance	**0.00**
14,06,622.00		**10,98,231.27**	**14,06,622.00**		**10,98,231.27**

NIAB, Hyderabad
SP036(NG)-Feasibility of producing cattle gonadotropins in milk of rabbit by invivo gene transfection
P.I: Dr. Nirmalya Ganguli
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	41,12,302.00			0.00
41,31,800.00	Grant In Aid	11,90,858.00	1,08,073.00	Salaries - Manpower	4,24,920.00
89,575.00	Other Receipts	98,309.00	0.00	Consumables	19,04,409.00
0.00		0.00	1,000.00	Contingencies	38,893.00
0.00		0.00	0.00	Travel	32,772.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	21,96,365.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
42,21,375.00		**54,01,469.00**	**1,09,073.00**		**45,97,359.00**
0.00	Excess of Expenditure over Income	**0.00**	**41,12,302.00**	Closing Balance	**8,04,110.00**
42,21,375.00		**54,01,469.00**	**42,21,375.00**		**54,01,469.00**

NIAB, Hyderabad
SP037(NG)-Establishment of goat mammary epithelial/stem cell lines for the production of pharmaceutical interest proteins
P.I: Dr. Nirmalya Ganguli
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	9,28,738.14			0.00
29,97,500.00	Grant In Aid	2,30,746.00	33,600.00	Salaries - Manpower	2,20,000.00
64,098.00	Other Receipts	18,609.00	31,415.00	Consumables	4,35,733.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	20,67,844.86	Equipment	1,42,467.43
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
30,61,598.00		**11,78,093.14**	**21,32,859.86**		**7,98,200.43**
0.00	Excess of Expenditure over Income	**0.00**	**9,28,738.14**	Closing Balance	**3,79,892.71**
30,61,598.00		**11,78,093.14**	**30,61,598.00**		**11,78,093.14**

NIAB, Hyderabad
SP038(VB)-To investigate the mechanisms regulating the enigmatic .....staphylococcus aureus
P.I: Dr. Vasundhra Bhandari
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	12,89,122.00			0.00
22,96,933.00	Grant In Aid	9,40,000.00	47,200.00	Salaries - Manpower	2,01,100.00
42,881.00	Other Receipts	31,123.00	6,12,332.00	Consumables	82,598.00
0.00		0.00	3,000.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	2,00,000.00	Overheads	1,00,000.00
0.00		0.00	1,88,160.00	Equipment	7,45,859.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	23,981.00
23,39,814.00		**22,60,245.00**	**10,50,692.00**		**11,53,538.00**
0.00	Excess of Expenditure over Income	**0.00**	**12,89,122.00**	Closing Balance	**11,06,707.00**
23,39,814.00		**22,60,245.00**	**23,39,814.00**		**22,60,245.00**

NIAB, Hyderabad
SP039(SF)-Development of Novel Mucosal Delivery System and Testing its Efficacy Against Salmonella Infection
P.I: Dr. Syed Mohd Faisal
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	2,13,942.00			0.00
5,50,000.00	Grant In Aid	0.00	32,667.00	Salaries - Manpower	16,107.00
9,041.00	Other Receipts	2,812.00	3,10,008.00	Consumables	1,88,866.00
0.00		0.00	2,424.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
5,59,041.00		**2,16,754.00**	**3,45,099.00**		**2,04,973.00**
0.00	Excess of Expenditure over Income	**0.00**	**2,13,942.00**	Closing Balance	**11,781.00**
5,59,041.00		**2,16,754.00**	**5,59,041.00**		**2,16,754.00**

NIAB, Hyderabad
SP040(NRH)-Chicken or egg: Drivers of antimicrobial resistance in poultry in India
P.I: Dr. Nagendra R Hegde
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	57,58,438.00			0.00
63,18,400.00	Grant In Aid	0.00	1,77,492.00	Salaries - Manpower	8,32,000.00
1,12,070.00	Other Receipts	1,35,506.00	72,273.00	Consumables	5,12,147.00
0.00		0.00	45,928.00	Contingencies	1,55,384.00
0.00		0.00	3,76,339.00	Travel	89,484.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	21,49,980.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
64,30,470.00		**58,93,944.00**	**6,72,032.00**		**37,38,995.00**
0.00	Excess of Expenditure over Income	**0.00**	**57,58,438.00**	Closing Balance	**21,54,949.00**
64,30,470.00		**58,93,944.00**	**64,30,470.00**		**58,93,944.00**

NIAB, Hyderabad
SP041(GKR)-"Understanding the mechanism of host innate immune suppression by the Brucella effector protein, TcpB to identify novel drug targets for brucellosis"
P.I: Dr. Girish K Radhakrishnan
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	1,54,124.00			0.00
8,60,000.00	Grant In Aid	8,64,000.00	0.00	Salaries - Manpower	0.00
12,363.00	Other Receipts	8,018.00	6,55,572.00	Consumables	7,98,577.00
0.00		0.00	0.00	Contingencies	675.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	62,667.00	Overheads	62,667.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
8,72,363.00		**10,26,142.00**	**7,18,239.00**		**8,61,919.00**
0.00	Excess of Expenditure over Income	**0.00**	**1,54,124.00**	Closing Balance	**1,64,223.00**
8,72,363.00		**10,26,142.00**	**8,72,363.00**		**10,26,142.00**

NIAB, Hyderabad
SP042(MS)-"Molecular platform for pidemiology, disease mapping and development of diagnostics for economically important diseases of ducks."
P.I: Dr. Madhuri Subbiah, Sci-D
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	3,66,511.00			0.00
7,90,000.00	Grant In Aid	0.00	1,60,333.00	Salaries - Manpower	2,27,500.00
12,120.00	Other Receipts	4,052.00	2,26,070.00	Consumables	84,658.00
0.00		0.00	34,525.00	Contingencies	239.00
0.00		0.00	14,681.00	Travel	43,926.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
8,02,120.00		**3,70,563.00**	**4,35,609.00**		**3,56,323.00**
0.00	Excess of Expenditure over Income	**0.00**	**3,66,511.00**	Closing Balance	**14,240.00**
8,02,120.00		**3,70,563.00**	**8,02,120.00**		**3,70,563.00**

NIAB, Hyderabad
SP043(AKG)-Development of injectable nanofibrous implant for oestrus synchronization in cattle.
P.I: Dr. Amit Kumar Goyal
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	31,58,825.00			0.00
39,13,800.00	Grant In Aid	13,44,016.00	1,48,535.00	Salaries - Manpower	7,74,181.00
58,347.00	Other Receipts	61,724.00	1,26,287.00	Consumables	7,11,197.00
0.00		0.00	3,000.00	Contingencies	9,400.00
0.00		0.00	0.00	Travel	44,852.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	5,35,500.00	Equipment	11,37,150.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
39,72,147.00		**45,64,565.00**	**8,13,322.00**		**26,76,780.00**
0.00	Excess of Expenditure over Income	**0.00**	**31,58,825.00**	Closing Balance	**18,87,785.00**
39,72,147.00		**45,64,565.00**	**39,72,147.00**		**45,64,565.00**

NIAB, Hyderabad
SP044(PS)-Understanding the Epigenetics of Host Pathogen interaction during Bovine Theileriosis"
P.I: Dr.Paresh Sharma
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	15,20,079.91			0.00
23,10,000.00	Grant In Aid	9,50,000.00	26,092.00	Salaries - Manpower	2,18,400.00
23,962.00	Other Receipts	45,976.00	3,62,949.00	Consumables	7,77,686.00
0.00		0.00	13,230.00	Contingencies	6,140.00
0.00		0.00	23,296.00	Travel	0.00
0.00		0.00	1,50,000.00	Overheads	1,50,000.00
0.00		0.00	2,38,315.09	Equipment	10,25,827.91
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
23,33,962.00		**25,16,055.91**	**8,13,882.09**		**21,78,053.91**
0.00	Excess of Expenditure over Income	**0.00**	**15,20,079.91**	Closing Balance	**3,38,002.00**
23,33,962.00		**25,16,055.91**	**23,33,962.00**		**25,16,055.91**

NIAB, Hyderabad
SP045(ASD)-Characterization of spliceosome- associated Nine Teen complex (NTC) like proteins in Toxoplasma Gondii.
P.I: Dr. Abhijit S Deshmukh
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	17,40,875.00			0.00
18,88,800.00	Grant In Aid	0.00	45,760.00	Salaries - Manpower	1,71,600.00
20,489.00	Other Receipts	16,906.00	11,588.00	Consumables	4,26,088.00
0.00		0.00	0.00	Contingencies	27,280.00
0.00		0.00	0.00	Travel	21,664.00
0.00		0.00	75,000.00	Overheads	0.00
0.00		0.00	36,066.00	Equipment	10,41,795.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
19,09,289.00		**17,57,781.00**	**1,68,414.00**		**16,88,427.00**
0.00	Excess of Expenditure over Income	**0.00**	**17,40,875.00**	Closing Balance	**69,354.00**
19,09,289.00		**17,57,781.00**	**19,09,289.00**		**17,57,781.00**

NIAB, Hyderabad
SP046(SF)-Immunocharaterization of Lipopolysaccharide (LPS) from Leptospira:Towards develepment LPS based Vaccine."
P.I: Dr.Syed M. Faisal
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	17,85,695.00			0.00
19,92,000.00	Grant In Aid	0.00	0.00	Salaries - Manpower	2,24,000.00
17,917.00	Other Receipts	45,680.00	1,30,222.00	Consumables	2,20,779.00
0.00		0.00	4,000.00	Contingencies	29,802.00
0.00		0.00	0.00	Travel	47,695.00
0.00		0.00	90,000.00	Overheads	0.00
0.00		0.00	0.00	Equipment	11,47,191.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
20,09,917.00		**18,31,375.00**	**2,24,222.00**		**16,69,467.00**
0.00	Excess of Expenditure over Income	**0.00**	**17,85,695.00**	Closing Balance	**1,61,908.00**
20,09,917.00		**18,31,375.00**	**20,09,917.00**		**18,31,375.00**

NIAB, Hyderabad
SP047(SG)-"Development of peptide functionalized gold nanoparticles for efficient targeting and imaging of urokinase plasminogen activator receptor (uPAR) in cancer diagnostics"
P.I: Dr. Sonu Gandhi
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	1,64,323.00			0.00
5,06,740.00	Grant In Aid	5,00,000.00	35,000.00	Salaries - Manpower	1,80,000.00
3,096.00	Other Receipts	7,438.00	2,72,013.00	Consumables	2,53,007.00
0.00		0.00	1,500.00	Contingencies	25,349.00
0.00		0.00	0.00	Travel	12,144.00
0.00		0.00	37,000.00	Overheads	1,25,000.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
5,09,836.00		**6,71,761.00**	**3,45,513.00**		**5,95,500.00**
0.00	Excess of Expenditure over Income	**0.00**	**1,64,323.00**	Closing Balance	**76,261.00**
5,09,836.00		**6,71,761.00**	**5,09,836.00**		**6,71,761.00**

NIAB, Hyderabad
SP048(SG)-"Iron oxide nanoparticles peptide complexes for imaging of urokinase plasminogen activator receptor (uPAR) in cancer diagnostics."
P.I: Dr. Sonu Gandhi
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	6,74,546.00			0.00
9,49,836.00	Grant In Aid	5,13,329.00	42,800.00	Salaries - Manpower	2,28,800.00
6,851.00	Other Receipts	8,149.00	1,61,815.00	Consumables	2,02,369.00
0.00		0.00	5,394.00	Contingencies	5,806.00
0.00		0.00	0.00	Travel	27,036.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	72,132.00	Equipment	3,42,732.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
9,56,687.00		**11,96,024.00**	**2,82,141.00**		**8,06,743.00**
0.00	Excess of Expenditure over Income	**0.00**	**6,74,546.00**	Closing Balance	**3,89,281.00**
9,56,687.00		**11,96,024.00**	**9,56,687.00**		**11,96,024.00**

NIAB, Hyderabad
SP049(ASD)-"Development of lateral flow based chromatographic immunoassay using recombinant chimera antigens for point of care testing of Toxoplasma gondii infection."
P.I: Dr. Abhijit S Deshmukh
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	10,30,785.00			0.00
10,29,600.00	Grant In Aid	6,86,400.00	0.00	Salaries - Manpower	2,15,317.00
1,185.00	Other Receipts	25,021.00	0.00	Consumables	3,43,686.00
0.00		0.00	0.00	Contingencies	19,037.00
0.00		0.00	0.00	Travel	15,155.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
10,30,785.00		**17,42,206.00**	**0.00**		**5,93,195.00**
0.00	Excess of Expenditure over Income	**0.00**	**10,30,785.00**	Closing Balance	**11,49,011.00**
10,30,785.00		**17,42,206.00**	**10,30,785.00**		**17,42,206.00**

NIAB, Hyderabad
SP050(AS)-"Establishment of genome manipulation technology in Theileria parasite for identification of gene involved in transformartion of host cell."
P.I: Dr. Anand Srivastava
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	11,53,680.00	0.00	Salaries - Manpower	1,71,045.00
0.00	Other Receipts	36,554.00	0.00	Consumables	1,92,872.00
0.00		0.00	0.00	Contingencies	24,824.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	50,000.00
0.00		0.00	0.00	Equipment	1,99,710.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**11,90,234.00**	**0.00**		**6,38,451.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**5,51,783.00**
0.00		**11,90,234.00**	**0.00**		**11,90,234.00**

NIAB, Hyderabad
SP051(RKG)-"Genomics assisted pathobiology to identify novel targets for diagnosis and therapeutic intervention(s) of Japanese encephalitis and Leptospirosis"
P.I: Dr. Ravi Kumar Gandham
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	2,61,12,764.00	0.00	Salaries - Manpower	6,61,280.00
0.00	Other Receipts	7,29,408.00	0.00	Consumables	43,49,412.00
0.00		0.00	0.00	Contingencies	1,19,152.84
0.00		0.00	0.00	Travel	1,25,578.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	96,89,669.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**2,68,42,172.00**	**0.00**		**1,49,45,091.84**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**1,18,97,080.16**
0.00		**2,68,42,172.00**	**0.00**		**2,68,42,172.00**

NIAB, Hyderabad
SP052(HBD)-"Development of large animal models and Polyherbal medicines to treat ovarian cysts in livestock"
P.I: Dr. HBD Prasada Rao
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	23,21,120.00	0.00	Salaries - Manpower	1,87,075.00
0.00	Other Receipts	41,533.00	0.00	Consumables	6,39,662.00
0.00		0.00	0.00	Contingencies	63,804.00
0.00		0.00	0.00	Travel	4,740.00
0.00		0.00	0.00	Overheads	1,20,000.00
0.00		0.00	0.00	Equipment	10,00,000.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**23,62,653.00**	**0.00**		**20,15,281.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**3,47,372.00**
0.00		**23,62,653.00**	**0.00**		**23,62,653.00**

NIAB, Hyderabad
SP053(PD)-"Identification and characterization of virulence factors of Aspergillus fumigatus field isolates from poultry chicken."
P.I: Dr. Prasad Dasari
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	24,72,000.00	0.00	Salaries - Manpower	8,35,424.00
0.00	Other Receipts	38,492.00	0.00	Consumables	3,31,251.00
0.00		0.00	0.00	Contingencies	57.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	50,000.00
0.00		0.00	0.00	Equipment	1,20,200.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**25,10,492.00**	**0.00**		**13,36,932.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**11,73,560.00**
0.00		**25,10,492.00**	**0.00**		**25,10,492.00**

NIAB, Hyderabad

SP054(VB)-Deciphering the role of efflux pumps in imparting antimicrobial resistance in staphylococcus aureus and their inhibitors in potentiating the existing therapy.

P.I: Dr. Vasundhra Bhandari

Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	14,83,280.00	0.00	Salaries - Manpower	92,452.00
0.00	Other Receipts	26,396.00	0.00	Consumables	5,13,773.00
0.00		0.00	0.00	Contingencies	572.50
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	1,37,100.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**15,09,676.00**	**0.00**		**7,43,897.50**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**7,65,778.50**
0.00		**15,09,676.00**	**0.00**		**15,09,676.00**

NIAB, Hyderabad

SP055(BD)-Limiting antimicrobial resistance by inhibiting diadenylate cyclase (DAC)- a bacterial second messenger biosynthetic enzyme involved in biofilm formation and cell wall intgrity.

P.I: Dr. Bappaditya Dey

Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	18,08,090.00	0.00	Salaries - Manpower	1,52,600.00
0.00	Other Receipts	30,935.00	0.00	Consumables	3,06,853.00
0.00		0.00	0.00	Contingencies	9,672.50
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	62,290.00
0.00		0.00	0.00	Equipment	4,09,384.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**18,39,025.00**	**0.00**		**9,40,799.50**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**8,98,225.50**
0.00		**18,39,025.00**	**0.00**		**18,39,025.00**

NIAB, Hyderabad
SP056(SM)-Understanding the mechanism of buparvaquone resistance in apiomplexan parasite theileriaannulata.
P.I: Ms. Shweta Murthy
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	9,93,200.00	0.00	Salaries - Manpower	2,92,640.00
0.00	Other Receipts	12,531.00	0.00	Consumables	2,48,854.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	88,000.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**10,05,731.00**	**0.00**		**6,29,494.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**3,76,237.00**
0.00		**10,05,731.00**	**0.00**		**10,05,731.00**

NIAB, Hyderabad
SP057(HBD)-An attempt to enhance the shelf life of an oocyte to increase the fertilazition time window.
P.I: Dr. H B D Prasada Rao
Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	44,69,210.00	0.00	Salaries - Manpower	71,310.00
0.00	Other Receipts	20,473.00	0.00	Consumables	36,658.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**44,89,683.00**	**0.00**		**1,07,968.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**43,81,715.00**
0.00		**44,89,683.00**	**0.00**		**44,89,683.00**

NIAB, Hyderabad

SP058(SA)-Identification of key molecular factors involved in resistance/susceptibility to paratuberclosis infection in indigenous breeds of cows

P.I: Mr. Sarwar Azam

Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	17,61,280.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	8,276.00	0.00	Consumables	0.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	0.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**17,69,556.00**	**0.00**		**0.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**17,69,556.00**
0.00		**17,69,556.00**	**0.00**		**17,69,556.00**

NIAB, Hyderabad

SP059(MS)-Molecular biological studies on porcine reproductive & respiratory syndrome (PRRS) virus in pig population of North East Region of India for development of sustainable diagnostics and vaccine.

P.I: Dr. Madhuri Subbiah

Receipts and Payments Account from 01/04/2019 to 31/03/2020

Previous Year Amount Rs.	Receipts	Current Year Amount Rs.	Previous Year Amount Rs.	Payments	Current Year Amount Rs.
0.00	Opening Balance	0.00			0.00
0.00	Grant In Aid	15,00,000.00	0.00	Salaries - Manpower	0.00
0.00	Other Receipts	705.00	0.00	Consumables	2,12,005.00
0.00		0.00	0.00	Contingencies	0.00
0.00		0.00	0.00	Travel	0.00
0.00		0.00	0.00	Overheads	50,000.00
0.00		0.00	0.00	Equipment	0.00
0.00		0.00	0.00	Books	0.00
0.00		0.00	0.00	AMC	0.00
0.00		0.00	0.00	Others	0.00
0.00		0.00	0.00	Transfer of Funds	0.00
0.00		**15,00,705.00**	**0.00**		**2,62,005.00**
0.00	Excess of Expenditure over Income	**0.00**	**0.00**	Closing Balance	**12,38,700.00**
0.00		**15,00,705.00**	**0.00**		**15,00,705.00**

मानव कल्याण के लिए पशु स्वास्थ्य

Animal Health for Human Welfare

राष्ट्रीय पशु जैव प्रौद्योगिकी संस्थान

National Institute of Animal Biotechnology

(An autonomous Institute of the Department of Biotechnology, Ministry of Science & Technology, Govt. of India)

Opp. Journalist Colony, Near Gowlidoddi, Extended Q City Road, Gachibowli
Hyderabad, Telangana, India PIN: 500 032
Email:admin@niab.org.in // Web: www.niab.org.in