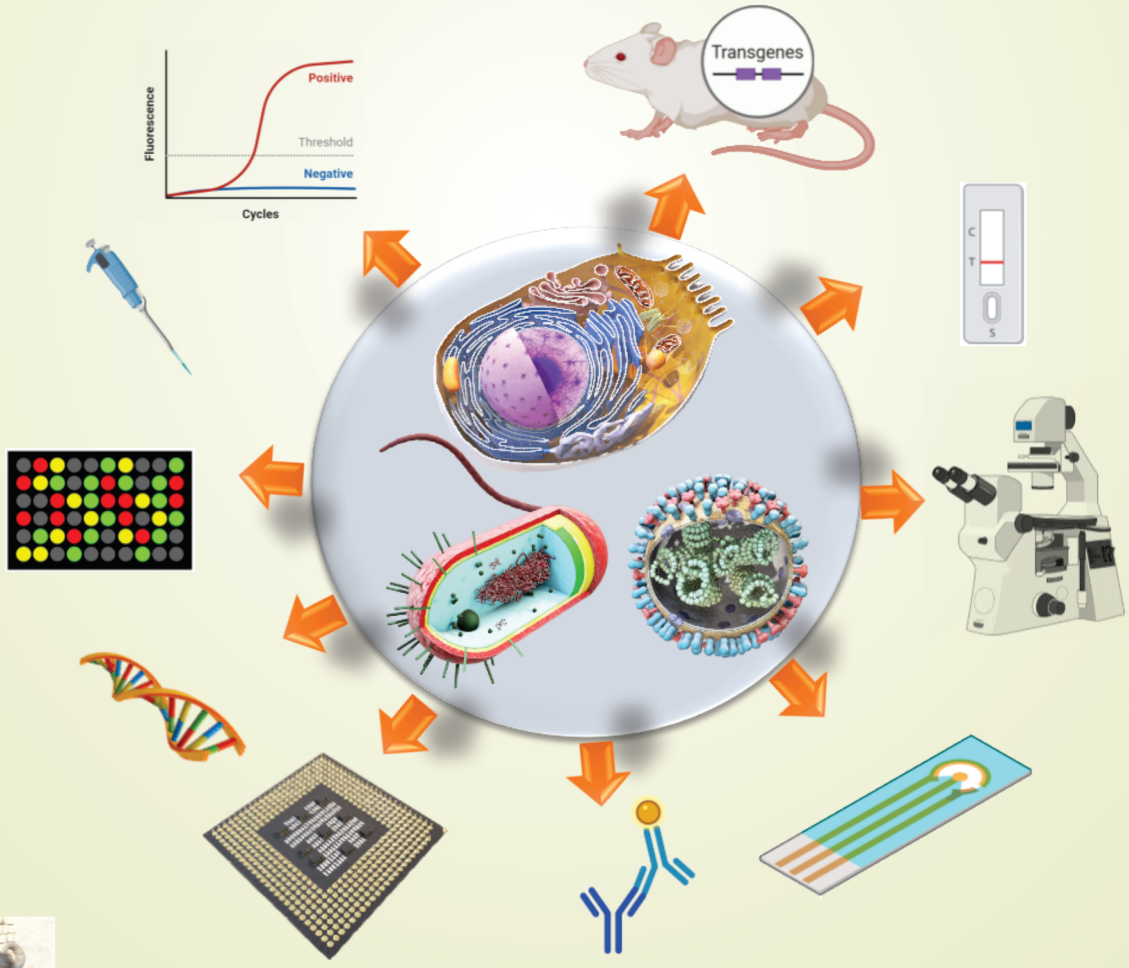
NIAB
National Institute of Animal Biotechnology

सत्यमेव जयते
DEPARTMENT OF BIOTECHNOLOGY
GOVERNMENT OF INDIA

TECHNOLOGY PROFILE AND RECENT INITIATIVES IN ANIMAL BIOTECHNOLOGY



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परमाणु उर्जा विभाग तथा अंतरिक्ष विभाग,
भारत सरकार

सत्यमेव जयते

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Ministry of Personnel, Public Grievances and Pensions,
Department of Atomic Energy & Department of Space,
Government of India

Message

I am pleased to note that Department of Biotechnology has taken up several initiatives towards enhancing the health and productivity of indigenous cattle breeds with a goal to help to augment rural livelihoods. The book "Technology Profile and recent Initiatives in Animal Biotechnology" covers details of technologies, diagnostic kits, vaccines developed through support of Department of Biotechnology.

I would like to compliment the team of DBT scientists, project investigators engaged in the implementation of R & D programme on various aspects of Animal Biotechnology.

(Dr.Jitendra Singh)

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MESSAGE

The livestock sector plays an important role in the economy of our country. The Gross Value Added (GVA) of this sector in financial year 2019-20 was 28.36% of agriculture and allied sector GVA and 5.21% of total GVA with a growth rate of 7.00% approximately. Livestock development will not only enhance livelihood, food, nutritional security and welfare of small, marginal and landless farming community but to whole nation. Our rich pool of livestock genetic resources needs not only better scientific management but also require R&D interventions to enhance their production and productivity.

The Department of Biotechnology has supported a large number of initiatives for new technology development addressing key livestock challenges. The DBT Autonomous Institute National Institute of Animal Biotechnology (NIAB) has played a major role on this alongwith many other centres across the county.

The details of some technologies/ diagnostics/ vaccines developed and major programmes initiated and supported by DBT as well as major technologies and programme initiated by NIAB in Animal Biotechnology programme have been enumerated in the form of compendium. All these technologies/ diagnostics/ vaccines have good potential for commercialization and application by dairy farmers.

I compliment all the scientists of the Animal Biotechnology programme for successful implementation of R&D projects and developing newer technologies. I hope this compendium of technologies and major programmes will be useful for researchers as well as industries involved in R&D and commercialization of products.

(Renu Swarup)

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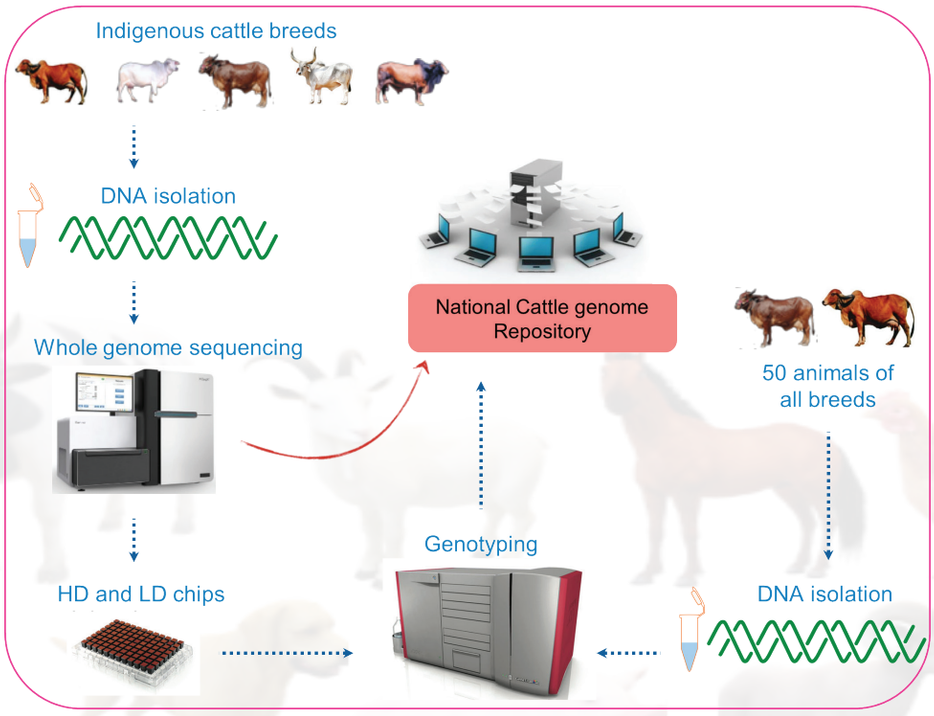
Content

DBT-NIAB SNP Chip - IndiGau

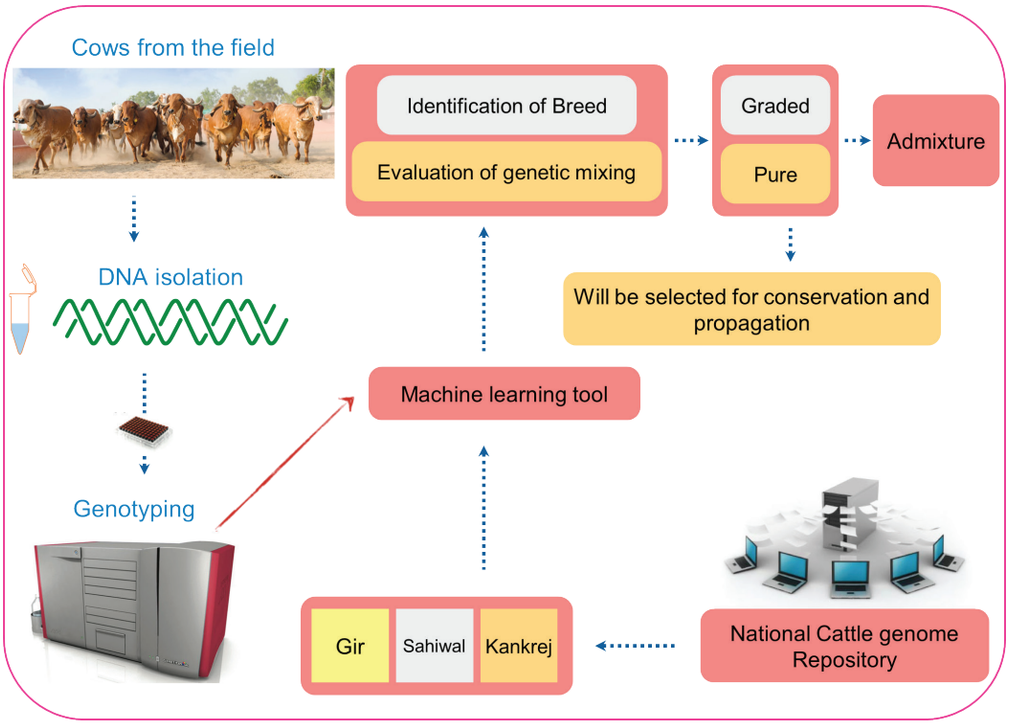
Technology developed: DBT-NIAB developed Genomics based world's largest SNP chip for cattle. This chip can be used to identify the pure indigenous breeds of cows to segregate them from mixed background to conserve germ plasm of native indigenous cows, as they contain many valuable traits. In the long run, this chip can be used for genomic selection of indigenous cattle, especially elite bulls, for important economic traits like milk yield, disease resistance and heat tolerance.

Utility of the Product: To meet the growing demand of milk in India several crossbreeding programs were taken up and every state has its own crossbreeding policy. This resulted in breed dilution of our valuable indigenous cattle in their native breeding tract leaving behind very few purebreds in comparison to graded cattle. For genomic selection to be implemented in India, there is an urgent need to identify the purebreds. The chip developed would identify the admixture in Indian cattle for selection of purebreds so that they can be segregated and propagated . In the long run, the chip will help in identifying productive bulls at a very early age. This may further help in increased genetic gain and reduction of generation interval.



Process of development of the SNP chip: It was a two-stage process. The two-stage strategy involved, initial whole genome sequencing of 176 samples representing 43 breeds of indigenous cattle breeds to decipher SNPs for development of a screening chip with 1,290,488 markers. SNPs were deciphered using two tools - freebayes and GATK, then SNPs were filtered stringently and spaced using customized space software. These markers were accommodated on two chips - NIABV1_A with 645,332 and NIAB_V1_B with 645,256 markers, with a minimum of two repetitive-tiling. The SNPs taken were equally distributed across all the chromosomes. In the second stage, this high-density screening chip was screened across 192 animals, which included trios (sire, dam and progeny), duplicates and breeds covering all the six groups in which the breeds were classified. The High-resolution Polymorphic markers on the screening Chip were selected to be spaced on the final IndiGau chip. A total of 788,496 SNPs markers, maximum for a bovine chip are present on the

IndiGau chip. This chip with a call rate greater than 98% was validated among duplicates, trios and across breeds. This two-step strategy approach to develop an SNP chip is novel . This chip is world's largest cattle chip, in terms of SNPs placed and can be used by many adjoining Asian countries.



Contact details

Subeer S Majumdar
NIAB, Hyderabad

Ravi Gandham
NIAB, Hyderabad

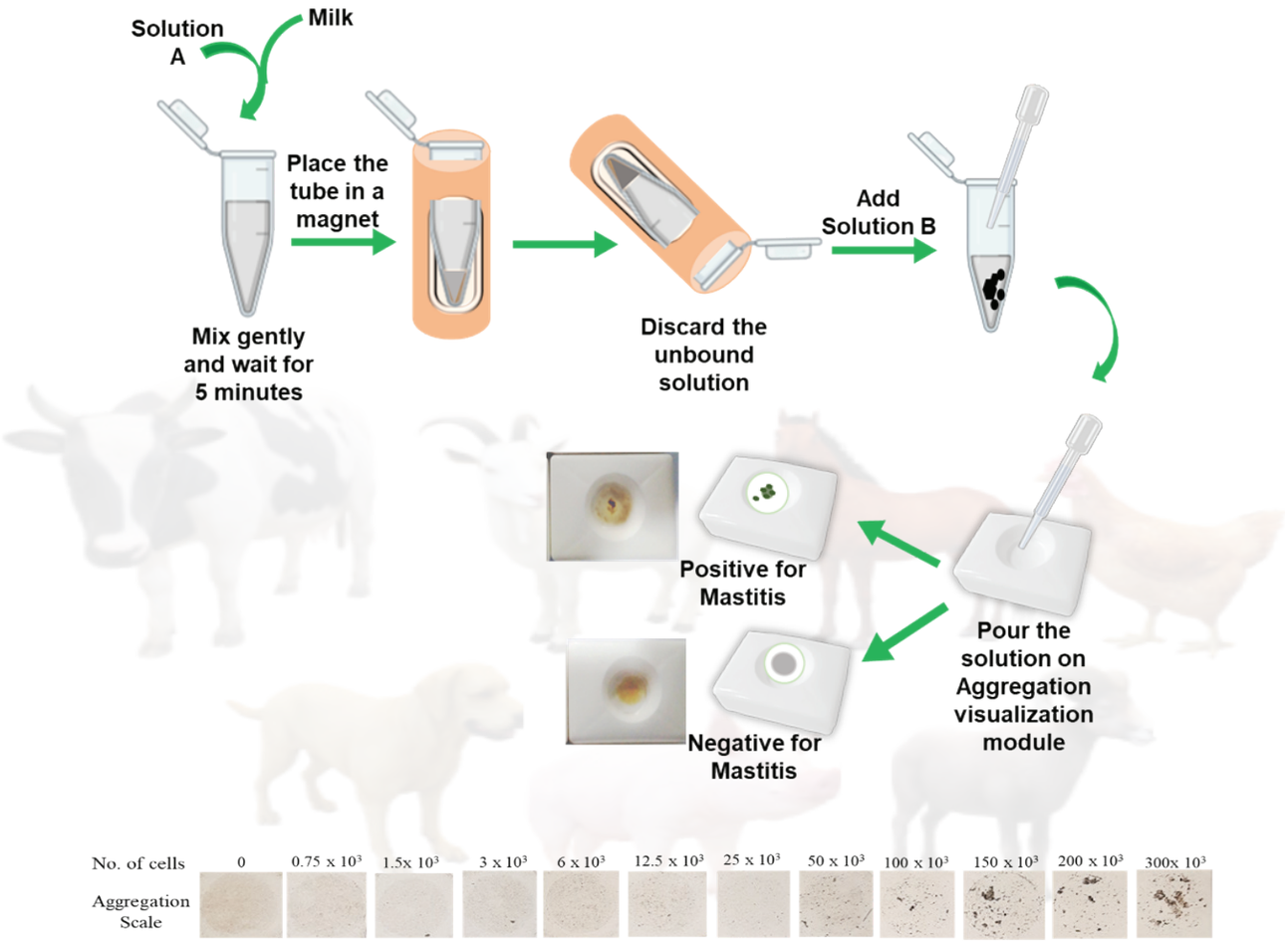
Sarwar Azam
NIAB, Hyderabad

Early Detection of Mastitis

Technology/Product: National Institute of Animal Biotechnology has developed subclinical and clinical mastitis detection kit. This is a simple, rapid cow-side test having advantage of distinguishing clinical and subclinical mastitis as compared to the currently used gold standard method (California Mastitis Test). It doesn't require any high end equipment and results can be obtained within 10 minutes and a quick screening of several samples can be done with 200 times higher limit of detection as compared to CMT. The overall cost to perform one test is less than Rs 10/test.

Utility of the Product: Mastitis is a disease of major economic importance and leads huge loss in the dairy industry and has public health significance. Detection of subclinical mastitis is a major bottleneck to control the disease spread within herd. Hence, detection of mastitis at an early stage is of high importance and has high prognostic value. It is in the process of technology transfer.

Process of Detection:



Method for detection of subclinical and clinical Mastitis

Contact Details:

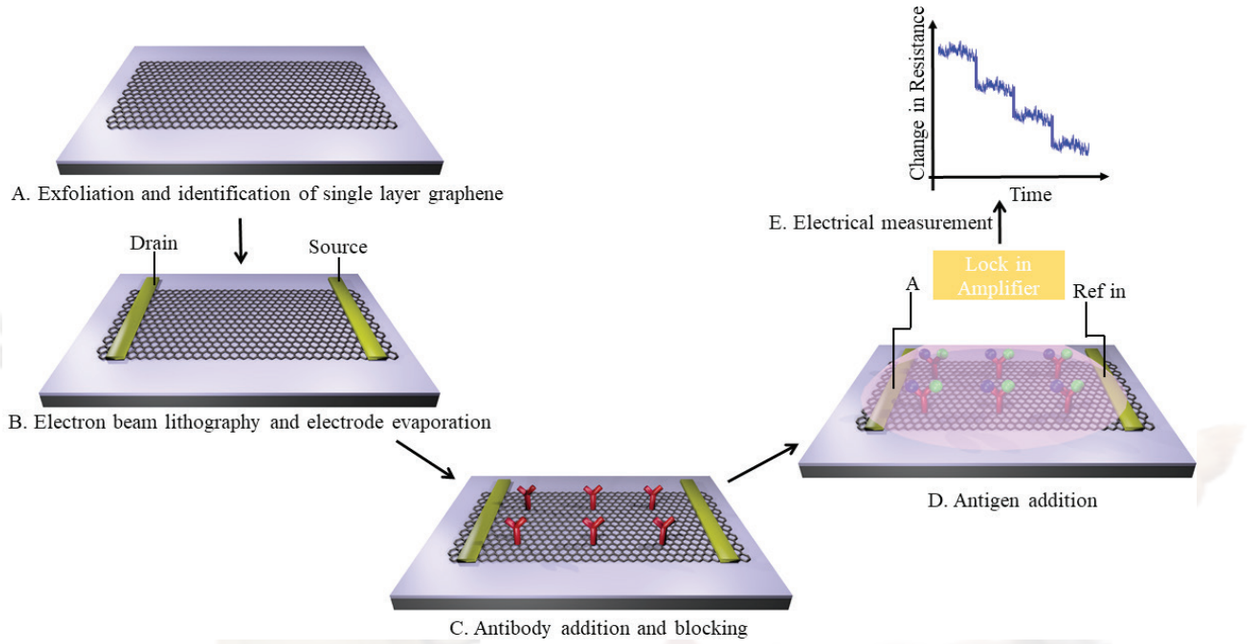
Dr. Pankaj Suman
Scientist D
National Institute of Animal Biotechnology, Hyderabad

Graphene based immunosensor for detecting JEV

Technology/Product: National Institute of Animal Biotechnology has developed antibody based biosensor for Japanese encephalitis (JE), wherein a compact and user-friendly graphene field effect transistor (GraFET) based ultrasensitive biosensor, which detects change in electrical resistance due to antigen-antibody interaction. The sensors showed very low limit of detection (LOD) of JEV antigen under optimised conditions.

Utility of the Product: Japanese Encephalitis Virus (JEV) exists in a zoonotic cycle between the *Culex* mosquitos as the transmission vector, pigs as the amplifying host (98-100% infection rate), water fowl as the reservoir host and humans/cattle/horses as the dead end host. The disease is prevalent in South and Southeast Asia, and can lead to death or prolonged neuropsychiatric sequelae. Early and accurate diagnosis of JE is important for appropciate course of medical treatment as well as to apply control measures. The developed method could help in rapid diagnosis and aid in the control of the disease or the spread of JEV.

Process of Detection:



Steps involved in the sensing of Japanese encephalitis

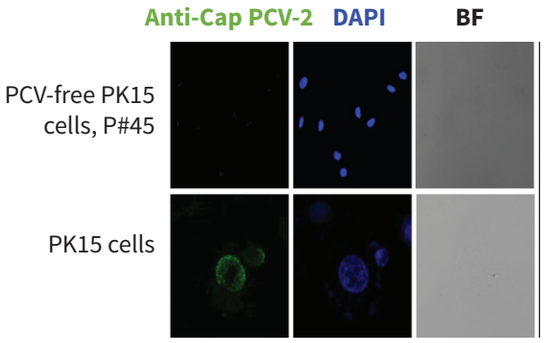
Contact Details:

Dr. Sonu Gandhi
Scientist D
National Institute of Animal Biotechnology, Hyderabad

Porcine circovirus (PCV)-free Porcine Kidney cell line

Technology/ Product: The Porcine Kidney epithelial (PK-15) cell line (ATCC, # CCL-33) is positive for porcine circovirus (PCV) antigens and hence cannot be used for the production of any biologicals since PCV is an extraneous agent. Currently, there is no commercial source of PCV-free PK15 cells. We have generated PCV-free PK15 cells at NIAB in collaboration with CAU, Mizoram.

These cells were generated by single cell cloning technology through serial limiting dilution method. The PCV-free PK15 cells have been tested at various passages for absence of the PCV-1 and PCV-2 antigens by PCR, droplet digital PCR, Quantitative PCR, Western blotting and Immunofluorescence assays.



Immunofluorescence using anti PCV-2 capsid antibody (also cross-reacts with PCV-1). PCV-free PK15 cell (SCC) at passage #45 tested negative.

Utility of the Product: Avaiability of cell lines free of extraneous agents is critical for both basic and applied research as well as industrial applications of product development. Our cell line will be helpful for research applications such as but not limited to culturing viruses, to study viral biology, to understand the host response during virus infection, for developing vaccines and diagnostics. These PCV-free PK15 cells are now available for research use through BCIL.

Contact Details:

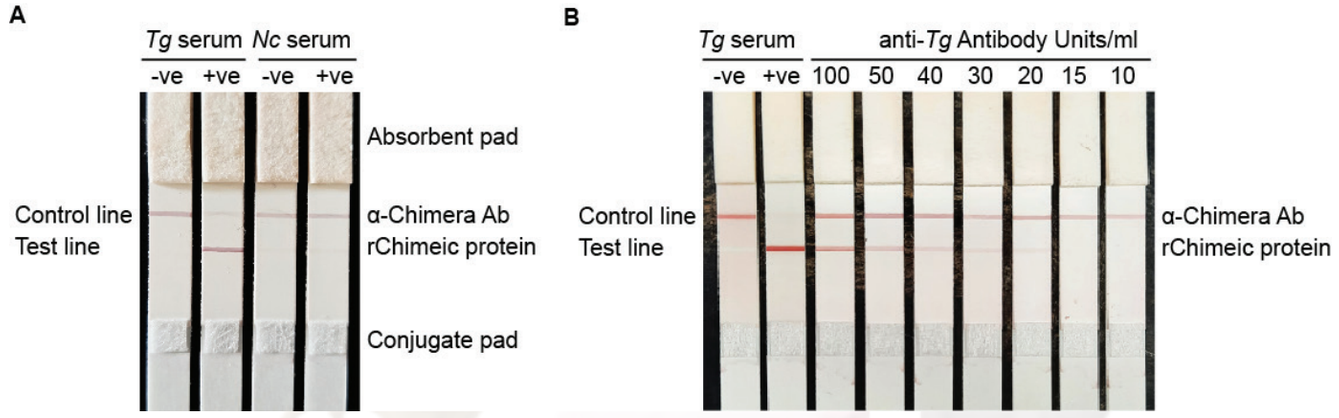
Dr. Madhuri Subbiah
Scientist D
National Institute of Animal Biotechnology Hyderabad

Test for diagnosis of toxoplasmosis in animals and humans

Technology: A lateral flow assay for detection of toxoplasmosis in animals and humans is developed. This test is simple, rapid (10 min) and does not require any specialized equipment for result visualization or interpretation. The developed technology is specific and sensitive to commercially available ELISA kits. The developed assay is very cost effective.

Utility of the Technology: Toxoplasmosis, a zoonotic infection caused by the protozoan parasite, *Toxoplasma gondii*, has a relevance to both human and veterinary medicine. *T. gondii* has a worldwide distribution and is a major cause of congenital disease, abortion and stillbirth in farm animals besides humans, leading to significant economic losses. Diagnosis of toxoplasmosis relies mainly on serological tests particularly ELISA. The commercial ELISA test is not only expensive but also requires sophisticated instruments and skilled technicians to interpret the result. In view of this, we have developed a rapid lateral flow point-of-care test for detection of anti-*T. gondii* antibodies in the serum of both animals and humans.

Method of Detection: The test consists of a conjugate pad containing recombinant *T. gondii* antigen conjugated with colloidal gold and a nitrocellulose membrane strip containing test band and a control band. The test band is pre-coated with *T. gondii* antigen, and the control band is pre-coated with antibodies specific against *T. gondii* antigen. When a test serum sample is dispensed onto the sample pad, the specimen migrates by capillary action. Antibodies if present in the serum, will bind to the *T. gondii* conjugates. The immunocomplex is then captured on the membrane by the pre-coated *T. gondii* antigen forming a colored test line, indicating a reactive test result. Absence of any test line suggests a negative result. The test contains an internal control which should exhibit a coloured line in the negative result. Third party validation is achieved.



LFA for detection of anti-T. gondii (Tg) antibodies. (A) Lane 1, Tg (-); lane 2, Tg (+); lane 3, Neospora caninum Nc (-) and lane 4, Nc (+). No cross-reactivity with phylogenetically related parasite N. caninum (B) Limit of detection: ≥20U/ml anti-Tg antibodies.

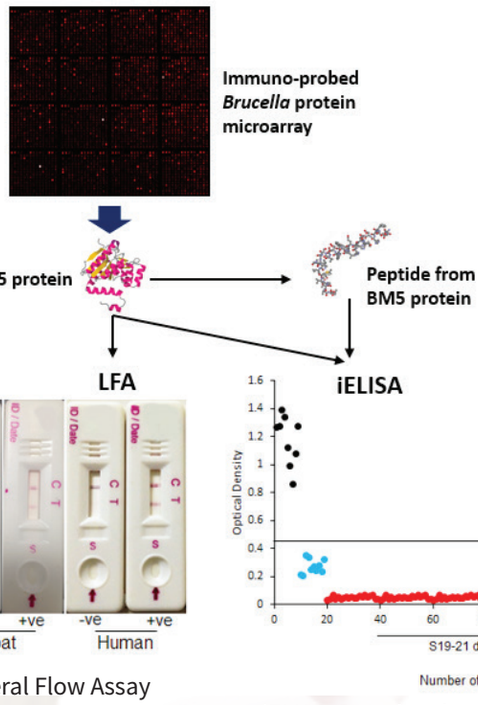
Contact Details: **Dr. Abhijit S. Deshmukh**
Scientist D
National Institute of Animal Biotechnology Hyderabad

Diagnostic assays for brucellosis with the ability to differentiate infected and vaccinated animals (DIVA)

Technology/Product: The National Institute of Animal Biotechnology has developed indirect ELISA (iELISA) and Lateral Flow Assay (LFA) based on the immunodominant protein, BM5, of *Brucella*, that was identified using a high-throughput immunoprobing of the *B. melitensis* protein micro-array. The technolgy is transferred to an industry.

Utility of the Product: Brucellosis in livestock and its impact on public health causes an annual loss of Rs. 22,800 crores in India. Early detection and control of brucellosis in livestock is important for controlling the disease in humans. The existing diagnostic assays for brucellosis are expensive and lack "Differentiating Infected from Vaccinated Animals" (DIVA) capability. The BM5-based assays can detect animal and human brucellosis and can efficiently differentiate vaccinated from naturally infected animals.

Process of Development:



A prototype Lateral Flow Assay device based on the BM5 protein

iELISA: Dot plot showing the DIVA capability of BM5 peptide-based iELISA (Black: +ve serum; Blue: -ve serum; Red: S19 vaccinated serum)

Contact Details:

Dr. Girish K Radhakrishnan
Scientist E
National Institute of Animal Biotechnology Hyderabad

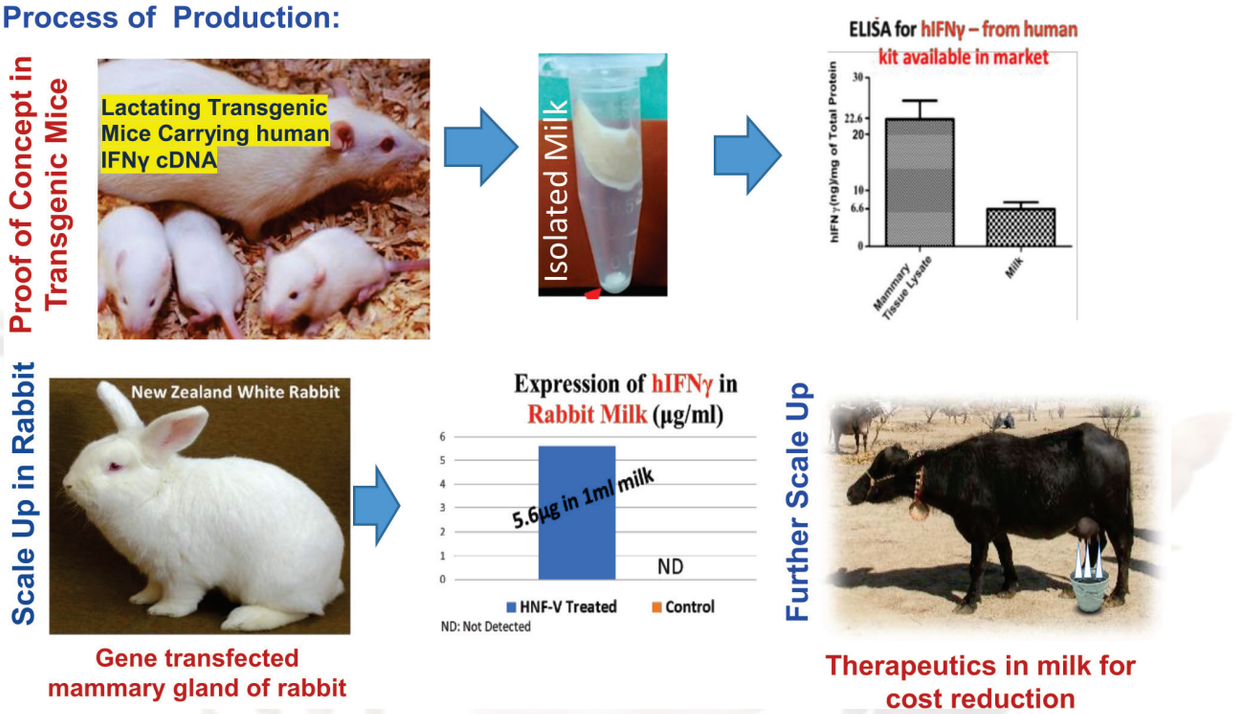
Technology for Production of Therapeutic Protein(s) in Milk for Increased Affordability by Masses

Technology/ Product: Therapeutic proteins (TP) have a great role in counteracting many diseases like diabetes, arthritis, blood clotting etc. However, exorbitant cost of producing various Therapeutic Proteins has placed them beyond the reach of common masses. Insulin, **α** and **Ɣ** interferons, blood coagulation factors etc. are some of most important marketable products. Milk based expression of these therapeutics in livestock animals has potential to *avoid expenses related to establishment and maintenance of an industry with manpower a*nd make them very cheap and affordable. NIAB has developed technology using mice and rabbits for generating these costly therapeutic proteins in the milk driven by buffalo beta casein promoter. Now, farm animals will be taken up for production of TP in milk. This would limit import of such therapeutics to India and make us self-reliant.

Utility of the Product: This technology, can remarkably reduce the cost of such therapeutics and increase their affordability by masses, alleviating sufferings of men and animals.

Process of Production:

Process of Production:



Gene transfected mammary gland of rabbit

Therapeutics in milk for cost reduction

Contact Details:

Dr. Subeer S. Majumdar
NIAB Hyderabad

Dr. Nirmalya Ganguli
NIAB Hyderabad

Nano-Newcastle disease virus vaccine

Technology/ Product Description: TANUVAS, Chennai has developed a Nanotechnology based Newcastle disease virus vaccine. This is the first nanotechnology-based vaccine of our country that has been licensed for commercial production and use in chickens. This technology has showcased the benefits of nanotechnology applications in vaccine delivery systems. This reiterates that successful 'productization' is possible through active academia-industry-funding agency linkage and is a testimony to Aatma- Nirbhar Bharat.

Utility: The advantages of this vaccine are two-fold. The vaccine is effective at 100-times lower dose than conventional (non-nano) vaccine. This implies that 100 times more doses can be manufactured with the same volume of virus-infective fluids than conventional vaccines. Further this nano vaccine is found to be more effective in the face of maternal antibodies while the conventional live vaccines would get neutralized by them.

Commercialization: The technology of nano Newcastle disease virus vaccine production has been transferred to M/s. Hester Biosciences Limited, Ahmedabad. The recipient company, after complying with all the regulatory processes, has received manufacturing license for the Newcastle disease vaccine Live Nano for both domestic use and export purpose.

Patent: Patent has been granted for the above technology of "Nano-Biomarker coupled Newcastle Disease Vaccine" vide patent no. 349908.

Nano-NDV Vaccine

Contact details:

Prof. G. D. Raj
Director, Animal Health Studies
Madhavaram Milk Colony, Chennai

Brucella abortus S19Δper vaccine

Technology/ Product Description: A novel Brucella vaccine viz. *Brucella abortus* S19Δper vaccine has been developed by IVRI, Izatnagar, through a Network project on Brucellosis supported by Department of Biotechnology(DBT), in which a gene was knocked out from *Brucella abortus* S19 strain.

Utility: Brucellosis is a zoonotic disease which causes huge production losses in livestock. The disease induces abortion at the last stage of pregnancy, infertility and other reproductive problem which causes losses in production of milk and meat. Globally, the disease is reported approximately in half a million human population every year too.In India, dairy farmers and veterinarians are at a huge risk of getting directly affected with the Brucellosis. The developed vaccine was also found to be DIVA compatible. *Brucella abortus* S19Δper vaccine can play an important role in National Brucellosis Control Programme initiated by Department of Animal Husbandry & Dairying, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India.

Commercialization: The technology of *Brucella abortus* S19Δper vaccine has been transferred to M/S Hester Biosciences ltd. on 22nd September, 2020 for commercialization.

Contact details:

Dr. Pallab Chaudhry
Indian Veterinary Research Institute
Izatnagar, Bareilly, UP 243164.

Preg-D Pregnancy Diagnosis Kit (Early pregnancy detection in Cattle and Buffalo)

Technology/ Product: The Preg-D kit is a urine based novel technique for early pregnancy diagnosis of cattle and buffalo. The method is based on a colorimetric test of least six metabolites forming a red-violet lactone derivative coloured conjugate [(2,5-Dihydro-4-methyl-5-(2,6,6-trimethyl-4-oxocyclohex-2-enylmethylene) furan-2-one], which has been named as **Preg-D** Bovine pregnancy diagnosis kit.

Utility of the Product: The kit is a very effective for identifying non-pregnant animals in the herd and can be used by the farmer. This kit is designed for testing of pregnancy after completion of oestrous cycle in cows/buffaloes and can preliminarily diagnose pregnancy as early as day 18 in majority of animals. Colour intensity is highest at around day 150 till end of pregnancy and this has been confirmed by measuring intensity at wavelength 665nm.

Process of Detection: The kit utilizes a simple thermophilic biochemical colour reaction in urine to diagnose pregnancy and results interpreted by seeing development of colour. A patent has been filed for the method developed (Ref. Indian Patent 'Urine based pregnancy detection method for ruminant livestock animals' filed vide application no. 202011013074)

Commercialization status: Ready for commercialization.

Preg- D bovine pregnancy diagnosis kit

Contact Details:

Dr. Ashok Kumar Balhara
Stress Physiology & Climatology
Central Institute for Research on Buffaloes, Hisar-125001

ELISA kit for monitoring health of Laboratory Animals

Technology/Product description: Recombinant antigen based ELISA kits have been developed for monitoring Sialodacryoadenitis virus (SDAV; Rat Coronavirus) and Kilham Rat virus (KRV; Rat parvovirus) infection in laboratory rats.

Utility of the Product: The ELISA kits are intended for monitoring Sialodacryoadenitis virus and Kilham Rat Virus infections in laboratory Rat colonies. The kits does not contain infectious components and are safe for use in animal houses. Both SDAV and KRV are transmitted by aerosols and by direct contact with biological secretions from the animals. Infection of laboratory rats with SDAV or KRV renders the rat unsuitable for experimental purposes. Detection of serum antibodies against these viruses is a best method to screen SDAV and KRV infections in laboratory rat population

Commercialization status: Ready for commercialization.

Collaborative Institutes:

Tamil Nadu Veterinary and Animal Sciences University, Chennai (project collaborators: Indian Institute of Science, Bangalore and National Institute of Animal Biotechnology, Hyderabad).

Translational Research Platform for Veterinary Biologicals (TRPVB)

The Translational Research Platform for Veterinary Biologicals (TRPVB) is an initiative of Department of Biotechnology (DBT), GoI with the Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), to facilitate a collaborative and coordinated approach for the translation of technologies in the area of veterinary vaccines and diagnostics. TRPVB works towards achieving the mission of translating of veterinary vaccines, diagnostics and other biologicals for field application and harness their benefit to improve animal health and productivity thereby augmenting the economic status of farmers.

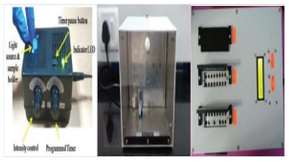
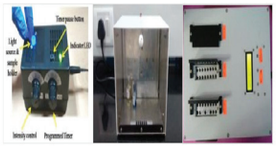
During short period of time, TRPVB has several 'achievements' in the area of technology development, technology commercialization, supply of in-house manufactured products, and offering high end biotechnology services to the farming community to its credit. Some of unique feature of TRPVB are as follows:

- **First translational platform** in animal sciences dedicated to develop and convert laboratory technologies for field use.
- **Evolution of six different commercialization strategies** to suit particular types / requirements of technology transfer.
- **cGMP licensed manufacturing facility** in an academic institute.
- **NABL accredited diagnostic services** for livestock diseases.
- **Unique amalgamation of academic, industry and regulatory expertise under one umbrella.**
- The **technology of 12 products were transferred** since inception with 5 products available at market shelf.
- Development of **unique products fulfilling unmet needs of animal sciences sector.**
- **Catering to national requirements** – antibiotic resistance, farm-gate technologies, brucellosis, tuberculosis control, etc.
- Offering various **animal disease diagnostic services** on clinical, regulatory and biotech based requirements at state and national leve.l
- **Fostering interdisciplinary research** leading to the development of newer technologies fulfilling unmet needs for the animal science industry.
- Creating the **participatory ecosystem and handholding** the industry during technology development and transfer.

The following products / technologies / services developed at TRPVB have dramatically changed the landscape in this sector

Technologies transferred to industry

Name of the Technology Developed		Technology details	Transferred details
1.	Quick Heal 	Collagen based wound healing cream for wounds such as cracks in teats, chronic and deep wound, maggot wounds.	M/s Sihil Pharma Companion Health Division, Chennai
2.	ABT Choice kit 	The kit employs a novel concept of using a magnetic nanoparticle mediated entrapment of the bacteria and avoids pre-enrichment. Test results are read visually by colour change and can be carried out at field level on wide variety of clinical samples.	M/s Genomix Molecular Diagnostics Private Limited, Hyderabad
3.	Bovine Masticure PGF 	A freeze dried preparation of “bovine platelet lysate” (BPL) can be used as an alternate complementary therapy for mastitis along with antibiotics. It accelerate healing of mammary gland parenchyma of mastitis affected animals.	M/s Hester Biosciences, Gujarat
4.	Collagen Beads 	Collagen beads were used to formulate a lentogenic-live Newcastle Disease vaccine for oral delivery. The vaccine delivered through collagen beads elicits similar levels of HI titers compared to commercial vaccine.	M/s Hester Biosciences, Gujarat
5.	Endomet B-PB 	Endo Met-PB treats mild and moderate case of endometritis in bovines as well as a post insemination supplement. Results showed significant decrease in nature of vaginal discharge in mild and moderate cases and significant reduction in leukocyte infiltration.	Commercialized to: M/s Genomix Molecular Diagnostics Private Limited, Hyderabad

6.	Bovine TB Alert 	Bovine TB alert kit™ is a rapid immune-chromatographic test for TB antibody detection with defined bovine TB specific antigens and crude Mycobacterium specific proteins meant for use in BTB sero-diagnosis.	Commercialized to: M/s Genomix Molecular Diagnostics Private Limited, Hyderabad.
7.	Portable Incubator 	A low-cost device, as a supportive device for use in areas where the temperature is low (especially with the ABT choice kit)	Commercialized to: M/s. Endhiram Innovations, Chennai
8.	LAMP device 	A low-cost battery-operated device. Enable performance of LAMP in field conditions	Commercialized to: M/s. Endhiram Innovations, Chennai
9.	CPV- VLP vaccine 	The virus like particle based vaccine for Canine Parvo virus using baculovirus expression System (BEVS) was developed. The VLPs present authentic surface epitopes to immune cells, unlike sub-unit vaccines. The VLP purified proteins do not replicate the immunized animals.	Commercialized to : M/s Palamur Biosciences, Hyderabad

Technologies developed and validated

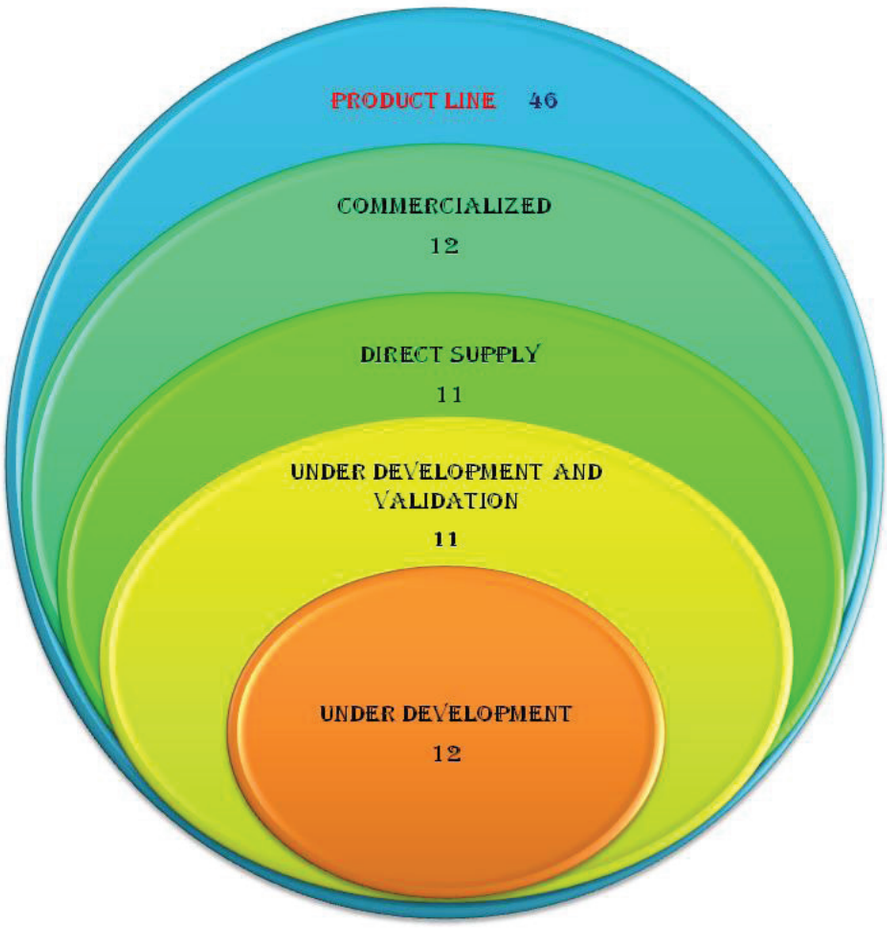
Technologies		Utility
1.	Nano ivermectin shampoo 	A novel nanotechnology-based ivermectin compound are encapsulated to increase the stability, reduce dosage to minimize toxicity with extended activity. It has antiparasitic and antimicrobial activity to prevent attack of parasitic diseases. This can be applied for dog infestations with ticks, fleas, mites and lice. Commercialization negotiation with: M/S Indriyam Biologics Pvt, Ltd., SCTIMST – TIMED, Kerala.
2.	Nano Ivermectin Spot On 	This is novel nanotechnology based Ivermectin Spot-On that can be applied for dogs. Ivermectin is a member of the macrocytic lactone class of parasiticides. It is commonly used as a heartworm preventative in small animals and for the treatment of certain types of external (e.g., mites) and internal parasites in dog infestations with ticks, fleas, mites and lice.

3.	ABT Detect 	A simple, ready-to-use broad spectrum microbial screening assay kit containing freeze dried *Geobacillus stearothermophilus* as test organism was developed for preliminary screening of antibiotic residues in meat and milk samples.
4.	A1/A2 milk testing kit 	Cow's milk protein constitutes around 30% of β-casein. It has been classified into two genetic types as A1 and A2. The A1 variant of β-casein upon digestion leads to the formation of beta casamorphin. The A2 variant has been shown to have a positive association with milk yield and protein content. This kit provides the ingredients that can be used to perform the assay at small scale lab set up.
5.	Lepto LAT 	Leptospirosis is a zoonotic disease of humans, domestic and wild mammals that poses a great threat to the public and personnel involved in their management. This Latex bead agglutination Test was developed as a quick preliminary field test to enable screening of suspected samples in field conditions. The recombinant antigen developed was coated on to latex beads and enables in testing the sera using agglutination as a criterion for serum positivity. The test is highly sensitive when compared with MAT test.
6.	TRPVB – Classic Dog Shampoo 	TRPVB classic shampoo is a cocoamido propyl betaine-based formulation with more effective ingredients such as decylglycosidase, PEG 7 glycerolcocoate, poly quaternium, HPMC for easy penetrating in the skin for the purpose of cleaning and maintaining healthy skin. It contains natural moisturizing agents that hydrate the coat and skin and aid in preventing dryness and irritation.
7.	Medicated gauze 	This nano medigauze is primarily for the wound healing applications. This product contains chlorhexidine/silver nanoparticles coated with cotton gauze. This chemical constituents in the form of nanoparticles exhibit bactericidal effect against Gram positive and Gram-negative bacteria.
8.	Metrozinc Gel 	Metronidazole gel prepared as a topical preparation (applied to the skin) of the antibiotic metronidazole and zinc oxide in the final formulation. It is an antibacterial and antiprotozoal formulation found to be effective against anaerobic bacterial infections including clostiridium and fusobacterium species.

9.	AMS beads 	This formulation contained enteric coated cellulose which retains the gastrointestinal microbiome and improves the immunity against the infections in chickens. The developed formulation with the applicability on chickens produced significantly reduced fecal oocysts.
10.	Probeads-EC 	Unique polymer based enteric coated probiotic beads. Targeted delivery of probiotic supplement for poultry birds so as to maintain gut health in chicken by competitive exclusion of pathogens.

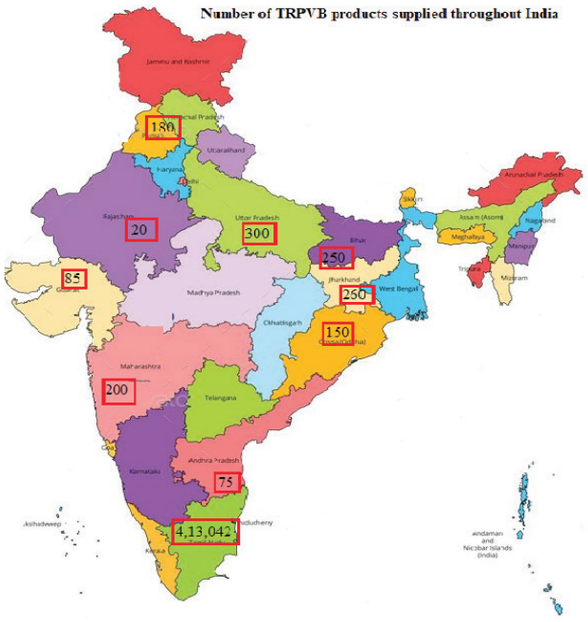
Biological products developed by TRPVB are widely used by the livestock/ poultry farmers and TRPVB has an in-house production unit for such products to cater the need of the farming community.

TRPVB PRODUCT LINE UP: AN OVERVIEW



TRPVB : Nationwide Products Supply

TRPVB's products have generated a wide interest among livestock/poultry farming community throughout the country. TRPVB has already established a strong supply base in Tamil Nadu. In the present phase, TRPVB has started to expand its product presence in the nationwide market



Name of the Product	Total units supplied
Teat Protect	242380
Progesterone Nano Cream	98218
TANUCHECK SCC Kit	18670
Progesterone Nano Patch	12560
Nano Heal	5620
Nano Dermal Cream	4899
Bru Alert	68
TANUVAS Surgical Kit	368
Nano Iodine	510
Ketochek	6278
Nano Guard	3028
Wild TB Alert Kit	340
ABT Choice Kit	468
Bovine TB Alert Kit	238
IVMEC Dog Shampoo	12
Viroclean	5362
Probeads EC	15381
Tick Shield	130
Green Tea coated AMS Beads	30

Patents Obtained/ Filed By TRPVB

S.No	PatentApplication Number	Title of Patent	Date of filing/ applying	Agency	Filled / Granted
1	2883/CHE/2014	Development of antimicrobial paper egg trays using air less spray surface coating approach based on with antimicrobial hybrid mixture	18.03.20	TRPVB TANUVAS	Granted on 25.06.2021
2	452/CHE/2014	Probiotic formulation for dog oral health	29.10.20	TRPVB TANUVAS	Awaiting for hearing
3	3690/CHE/2014	An improved diagnostic method for rapid detection or antibodies specific for pathogenic Mycobacteria in wild animals	28.07.15	TRPVB TANUVAS	Complete specification filed
4	202141008770	A method for detecting RBC/ Platelets bound antibodies in canines	02.03.21	TRPVB TANUVAS	Provisional Specification filed
5	202141023187	Method for preparing stable probiotic beads for use in poultry species and its compositions	24.05.21	TRPVB TANUVAS	Complete specification filed

Infrastructure Created at TRPVB

TRPVB General Laboratory (6900 Sq.ft)

TRPVB has managed to bring the animal healthcare/ production industry closer to academic institutions by technology transfers, regulatory services and expert consultations. In addition, TRPVB has supported the entrepreneurship culture by encouraging collaborations with several start-up companies. Such an achievement was made possible by the continued support of TRPVB's existence by the Department of Biotechnology, Government of India and TANUVAS. The continued existence of TRPVB will bring in several improvements and innovations in this still nascent translational research in animal biotechnology sector.

Clean Room Facility (2959 Sq.ft)

BSL2+ Laboratory (753 Sq. Ft.)

Contact details:

Prof. G. D. Raj
Director, Animal Health Studies
Madhavaram Milk Colony, Chennai

Canine Health Research

DBT initiated a PAN India programme on Canine Health Research to address major problems of canine upkeep and maintenances in terms of health, nutrition and therapy etc. to prevent zoonotic infection through integration of human and veterinary medicine interface for addressing one health concept in canine. Main features of this programme are as follows:

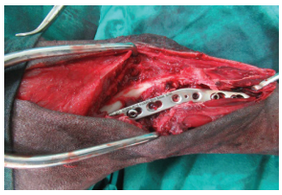
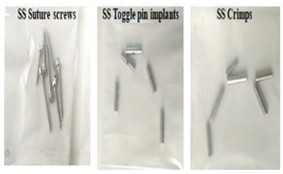
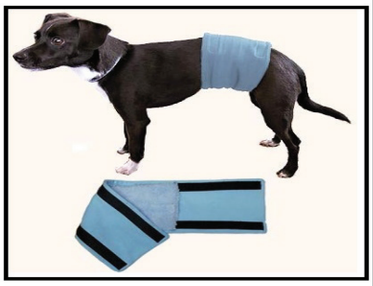
- **Establishment of two canine research centers:**
  - » Guru Angad Dev Veterinary and Animal Sciences University (GADVASU)
  - » Tamil Nadu Veterinary and Animal Sciences University (TANUVAS).
- **Networks of projects supported** : 6
- **Total number of projects supported**: 42
- **Total number of institutions involved:** 15

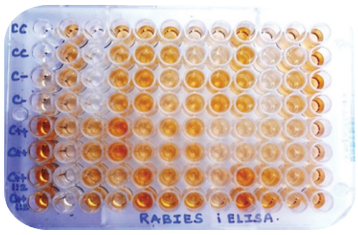
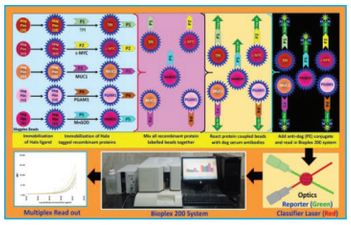
1. DBT-GADVASU Canine Research Centre and Networks

Products, Process and Technologies Developed:

Name of the Product/ Technology Developed		Technology details	Utility
1.	Extruded Dog Feed 	The formulated GADVASU extruded dog feed had better *in-vitro* digestibility compared to available commercial dog feeds with respect to dry matter, crude protein, ether extract and organic matter. The GADVASU dog feed, besides having better nutritional worth is also economical viable. The process/ technology is ready for transfer.	To provide balanced nutrition to puppies for better growth at economical rate
2.	Dog Biscuits 	The dog biscuits were formulated to meet the dietary requirement of pet dogs. Nutritionally balanced dog biscuits were fortified with 30% liver powder. The process/ technology is ready for transfer.	Dog biscuit would provide balanced nutrition at economical rate
3.	Indigenous Nylon Fishline Sutures 	Indigenous Fish line monofilament nylon suture analyzed for physical and mechanical parameters at IIT, Delhi and monofilament threads nylon fish line (0.90 mm diameter) found to be the strongest material followed by Nylon monofilament-G (0.85 mm diameter) and found to be appropriate for surgical purpose.Product is under validation	Indigenous Nylon Fishline Sutures are cost effective and are useful for joint stabilization during surgical intervention.

4.	Tibial Plateau Leveling Osteotomy (TPLO) plates 	TPLO plates have been designed from Stainless steel compatible to the body system showing no inadvertent tissue reaction. The TPLO plates consist of Left and right combinations and the plate designs include 3 angled proximal locking holes for providing better fitting on the shorter proximal border of the tibia. Product is under validation	Would be useful for the repair of cranial cruciate ligament rupture for stabilization of the stifle joint in dogs
5.	Toggle pin implants 	Toggle pin implants are designed from stainless steel material with central thread hole for use in different body weight dogs. These toggle pin implants are compatible with the body system and show no inadvertent tissue reaction. Their method of application is simple, and with little expertise can be used in routine practice.Product is under validation	Would be useful for the stabilization of hip joint in canines during surgical interventions
6.	Suture screws 	Cancellous Suture screws of variable length were developed for use at diverse places. The implants were having anchoring hole at the top of the screws for anchoring the suture materials. Product is under validation.	Would be useful for the stabilization of hip joint in canines during surgical interventions.
7.	Tibial tuberosity advancement (TTA) implants 	Three locking holed TTA cages having variable wedge thickness for cranial advancement of tibia, have been developed. Variable thickness is helpful for achieving variable degrees of advancement in animals suffering from cruciate ligament rupture. Product is under validation	Would be useful for repair of cranial cruciate ligament rupture and stabilization of the stifle joint.
8.	Sutures 	The knot less application of sutures is advantageous for femur head reposition and stifle stabilization techniques. Product is under validation	Would be useful for surgical treatment of joint arthropathies in canines
9.	String of pearl (SOP) plates 	Stainless steel String of Pearl plates have been designed (2.7 mm) for their applicability in bones having varying contours. Product is under validation	Would be useful in arthrodesis for the treatment of stifle osteoarthritis in dogs

10.	Angled joint arthrodesis plates 	Angled plates meeting the normal angles of different joints have been designed for joint arthrodesis procedures and proper stabilization of joints.Product is under validation	Would be useful for surgical treatment of joint arthropathies in canines
11.	Suture crimps 	Stainless steel suture crimps were designed for stabilization of hip & stifle joints during the treatment of canine arthropathies. Product is under validation	Useful for stabilization of hip & stifle joints during surgery in canines.
12.	Dental impression trays 	Dental trays were designed such that a single adjustable smart tray is suitable to take dental impression in all breeds of dogs having varying skull sizes useful for fabrication of metal dental crowns.Product is under validation	For taking dental impression dogs having varying skull sizes using a single tray.
13.	Dental Crowns 	Canine dental crowns were fabricated using CAM/CAD technology with 3DMP by using stainless steel (SS). 316 L powder was outlined by using a clay model of canine teeth which was scanned by a 3D scanner followed by preparation of digital computer aided design (CAD) data.	Would be useful for Root Canal Therapy in dogs
14.	decellularized porcine small intestinal submucosal (DPSIS) graft 	Porcine small intestinal sub mucosa was decellularisation with 1% SDS and assessed for the absence of lamina propria, tunica muscularis and cellular elements. Cyto-compatible and for mRNA expression of selected genes of ocular surface epithelium studied before acceptance as DPSIS graft.	Would be useful for the treatment of Kerato-conjuctivities Sicca in dogs
15.	Canine pregnancy detection device 	A portable and affordable acoustic sensor based canine pregnancy detection system is capable of analyzing fetal heartbeats as an indicator of gestation, fetal health condition, and litter size. With inbuilt advanced signal processing circuit, this state-of-the-art device is capable of processing parallel signals sourced from multiple fetal heartbeats. Product is under validation	For collecting fetal heartbeats residing in pregnant bitch& to find pregnancy status and tentative number of puppies

16.	Quantitative ELISA 	The immunodominant glycoprotein (G) gene of rabies virus expressed in *Spodoptera frugiperda* (Sf-21) insect cells. A recombinant RVL-G based quantitative ELISA has been standardized which performed at par with RFFIT for seromonitoring of vaccinal antibodies in dogs. Product is under validation	Would be useful for sero-monitoring rabies antibodies in dogs
17.	Assay for Canine Mammary Tumor 	Magnetic bead based immunoassay was standardized for detection of auto-antibodies to 11 selected TAAs (ERBB2, MMP-9, HSP90, MUCIN1, MMP-2, YKL40, TPI, PGAM, MnSOD, c-MYC and SURVIVIN). Product is under validation.	Would be useful for simultaneous detection of autoantibodies against Canine Mammary Tumor (CMT) biomarkers

DBT-GADVASU-Canine Research Centre

Contact Details: **Prof. J.P.S. GILL**

Director of Research, GADVASU, Ludhiana

DBT -TANUVAS Canine Research Centre and Networks

Salient achievements

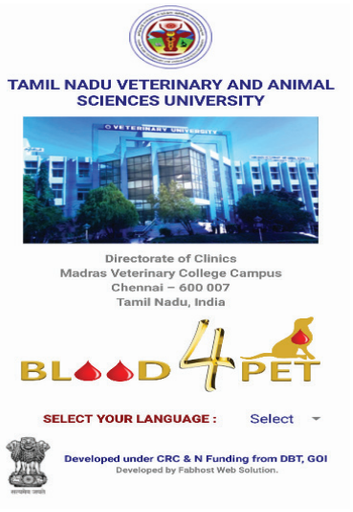
A. Products, Process and Technologies Developed: Under this programme, the investigators had developed 13 process/ products, 2 technologies and successful clinical intervention that are applicable for the efficient diagnosis and treatment of canine diseases.

- Multiplex PCR based assays had been developed and tested for its efficiency in differentiating CPV 2a & 2b and a common testing facility will be planned in discussion with DBT to offer this as a service
- An aptamer 1A-5A with moderate and specific binding to CPV had been developed and the same is now being tested for its *in-vitro* neutralization efficiency
- A multiplex PCR targeting the 18S gene fragments of B. vogeli, B. gibsoni and H. canis and virB9 gene fragment of E. canis had been optimized and is being tested for its efficiency
- A Recombinase polymerase amplification assay targeting the LipL32 gene had been optimized and preliminary screening reveals its ability to detect 100 Leptospires per ml of blood sample/ 5.3 pico-gram of genomic DNA
- A Styrene Maleic Anhydride (SMA) polymer developed by RAFT polymerization technique had been characterized and is now evaluated for its contraception efficiency through single intravasal injection
- An modified colorimetric assay had been developed for detection of ESBLs and the same is being evaluated using a panel of ESBL (+ve) and ESBL(- ve) isolates from dogs
- A Concanavalin-A based ELISA targeting the membrane glycoproteins of canine RBC's had been optimized and the same will be explored for it utility in identifying the naturally present DEA 1.1 antibodies in canine population (that are positive for the other blood types)
- The GnRH receptor based protein targets have been expressed in E.coli and preliminary immunization studies initiated in female beagle dogs provide encouraging results for contraception
- The CHOP therapy had been successfully applied to ~32% of the total lymphoma cases at MVC clinics
- The GnRH peptides have been conjugated to the surface of Rabies virus particles using a novel protocol. The conjugated viral particles are being characterized and its utility is being explored
- A kit to perform staining for immune mediated haemolytic anaemia at clinician level and an LFA kit for detecting Immunoglobulins on Red Blood Cells / Platelet surface had been developed for POC application.
- ***Blood 4 Pet mobile app*** – a first of its kind in India had been designed and developed in 3 languages viz. English, Tamil and Hindi to create awareness on blood donation and also connect interested pet parents as donor. Currently there are 250 pet parents are registered as on date

B. Whole genome sequencing of Genome Characterization: The whole genome sequence data has been generated for two isolates of Canine Distemper Virus & its Phylogenetic grouping confirmed.

C. Technologies transferred:

- A Tripartite agreement between a VIF incubate M/s. Jeshron, TRPVB and, Veterinary Incubation Foundation (VIF) @ TANUVAS had been initiated to provide doorstep diagnostic service for detection of EVANS in canines
- The process for a PCR based diagnosis of *Babesia gibsoni*, *Babesia canis*, *Babesia vogeli*, *Anaplasma platys* and *Ehrlichia canis* was transferred to Illumgene, Bengaluru and the same is being offered as a service at TRPVB/VIF on cost sharing model.



Contact Address: **Dr. S. Balasubramanian**
Director of Clinics
TANUVAS, Chennai - 07.

DBT Network Programme on bovine tuberculosis controlMycobacterial diseases in animal network (MyDAN)

DBT-MyDAN programme initiated by the Department of Biotechnology to address major problems associated with bovine tuberculosis (bTB). The main focus is to develop newer diagnostics and study the feasibility of BCG as a vaccine for cattle with an aim to control the TB. This programme is being implemented at eight centres namely TANUVAS, Chennai, LUVAS, Hisar, IVRI, Kolkata, IAH & VB, Bengaluru(Surveillance Unit), GADVASU, Ludhiana, AAU, Anand, Gujarat and WBUAFS, West Bengal and IAH & VB, Bengaluru (PMU).

Achievements

A. Products, Process and Technologies Developed:

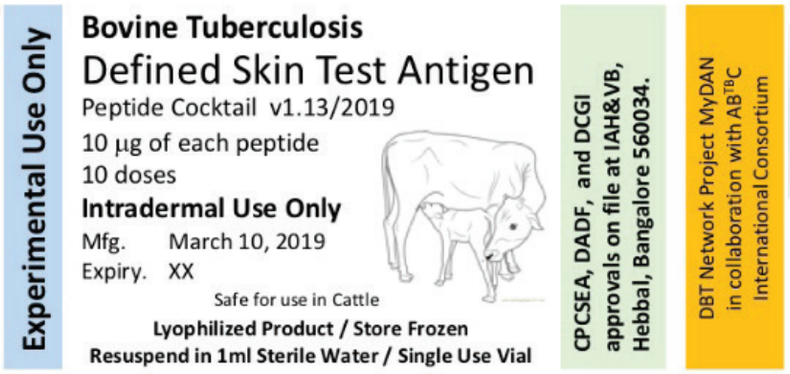
- Defined Skin Test was developed as an alternative for SICCT which is presently in use as a DIVA tool for TB before checking for the usability of BCG vaccine.
- Established safety of DST and immunogenicity of BCG in cattle and performed dose optimization of DST in buffalo. Immunogenicity studies of BCG vaccine for use in Bovines was carried out.
- Real-time PCR for speciation of TB complex bacteria from animals and humans developed.
- Monoclonals have been developed against M.bovis for indigenous development of IGRA kit.
- Production of PPD's (both PPD-A & PPD-B) for Bovine Tb for SICCT is being taken up under the project which will be major outcome as at present only one supplier is there for same globally.

B. Whole genome sequencing of Genome Characterization:

- The whole genome sequencing data has been generated for more than 5 isolates from different centres and the salient outcome as ***M. orygis*** being the major strain causing the clinical TB in bovines in India.

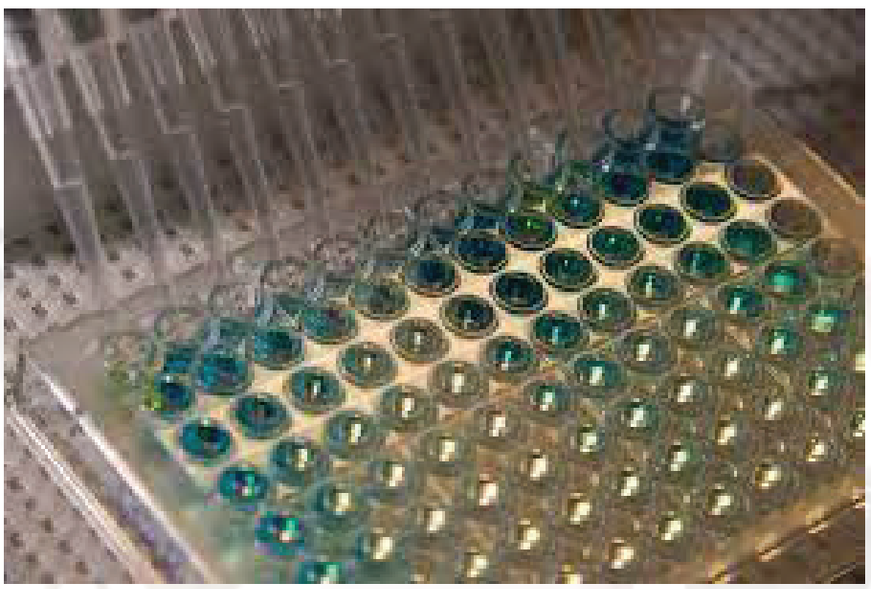
C. Technologies Developed:

- As part of the Defined Skin Test (DST) safety trials it was observed that there were no deaths, no treatment related changes in general health and behavior, no inflammation at injection site or effects on feed consumption, body weight or body weight gain in both the phases of the study.



- Initial data of evaluation of Defined Skin Test using Synthetic peptides is providing promising results. The DIVA capabilities of this diagnostic technique, will in turn open the way for use of vaccination against Bovine TB in the future course.

- Pilot BCG Efficacy Study in cross-bred cattle, alongside Preliminary Analyses revealed that the BCG in calves may be a promising solution for control TB in bovines.and the study highlighted the DIVA potential of DST antigen.
- Indigenous IGRA kit development for Bovine TB is on track and required monoclonals has been in progress which will be a major outcome as at present we are importing these kits from abroad.



DBT Network Programme on Anthrax Diagnosis and Control in India

Anthrax remains endemic in India and presents a threat, not only to human and animal health, but also possibly to India's national bio-security. Incomplete surveillance, lack of risk communication strategies to the public and policymakers, acquaintance lacuna in transmission dynamics of circulating strain(s), lack of rapid diagnostics and isolated research are just a few of the reasons that anthrax has remained an insurmountable problem in India.

Department of Biotechnology, Government of India, has therefore initiated a Network programme on Anthrax to bridge these vital gaps which will in formulation of rational strategies for the implementation of effective national disease surveillance and control programs including accurate risk assessment and the development of disease control policy frameworks in India.

The Anthrax-India Network Project (A-INP), "DBT Network Programme on Anthrax Diagnosis and Control in India" will provide a multi-disciplinary research consortium with involvement of 10 partnering Institutes/ Universities. This will strengthen the competences for surveillance, outbreak investigation, laboratory capacity, vaccination, specific predictors of outbreak risk and risk mapping. Training and enhanced capabilities will provide scientists, policymakers, and key stakeholders the information and tools required for the cost-effective control and eventual elimination of anthrax from endemic regions in India. Genomics/ molecular based epidemiologic approaches will identify host- and region-specific strains of *B. anthracis* to better enable attribution of source of infection and inform predictive risk models and to develop detailed *B. anthracis* strain map in India. Considering biosecurity importance of *B. anthracis* alternative therapeutic models such as phage display technique, use of peptide(s) or nucleic acid-based model for development of therapeutic molecules will be developed to be ready to tackle the adverse situations/bioterrorism. Novel vaccine candidates through the pan-genome-based reverse vaccinology strategies will also be developed in the project to safeguard the animals, wild animals and humans, which in turn will benefit the public from this fatal zoonotic disease.

This network programme will be anchored by Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana and following institutes/ Centres are collaborating in this programme:

1. National Research Centre on Equines, Hisar, Haryana
2. Odisha University of Agriculture and Technology, Bhubaneshwar, Odisha
3. Institute of Animal Health and Veterinary Biologicals, Bengaluru, Karnataka
4. ICAR-Directorate of Onion and Garlic Research, Rajgurunagar, Maharashtra
5. Jawaharlal Nehru University, New Delhi
6. Sri Venkateswara Veterinary University, Tirupati, Andhra Pradesh
7. ICAR-National Research Centre on Meat, Hyderabad
8. Christian Medical College, Vellore, Tamil Nadu
9. Madurai Kamraj University, Madurai, Tamil Nadu
10. Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana

सत्यमेव जयते

Department of Biotechnology
Ministry of Science & Technology