



NEW TECHNOLOGIES DEVELOPED

Maharashtra Animal & Fishery Sciences University, Nagpur



**Mumbai Veterinary College,
Mumbai**



**Nagpur Veterinary College,
Nagpur**



**College of Veterinary and Animal
Sciences, Parbhani**



**College of Veterinary and Animal
Sciences, Udgir**



**Krantisinh Nana Patil College
of Veterinary Science, Shirwal, Satara**



**Post Graduate Institute of Veterinary
& Animal Sciences, Akola**



**College of Fishery Science,
Nagpur**



**College of Fishery Science,
Udgir**



**College of Dairy Technology,
Warud, Pusad**



**College of Dairy Technology,
Udgir**



- Livestock sector is directly related with farming system and has major contribution in Indian agricultural GDP.
- The sustainable development of livestock sector depends on availability of feeds and fodders which contributes about 60–70% of cost of production but the status of feeds and fodders are declining day by day, which can be controlled by minimizing wastage and increasing judicious use of available feed and fodder resources with innovative intervention for poor and marginal farmers.
- As such, for sustainable livelihood security of farmers a simple scientific and technological approach is cattle biscuit machine and cattle biscuits.

Cattle Biscuit Machine (farmers hand press feed supplement block machine)

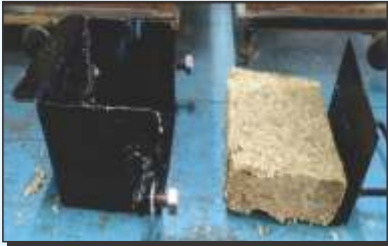
- Cattle biscuit machine is a simple hand press feed block machine to prepare feed blocks for feeding dairy animals.
- Machine is made from the non rusted iron material and has compression facility with the screw rod type rotator and has rectangular mould in which the feed material is filled which is used for preparation of cattle biscuits and compressed with the help of hand pressed machine which is very much economical for poor and marginal farmers.



Preparation of cattle biscuit

- The ingredients composition of cattle biscuit is ground maize (5–10%), cottonseed cake (15–20%), wheat bran (40–45%), limestone powder (6%), urea (4%), jaggery (15–18%), mineral mixture (2%) and salt (2%). Initially measure all the ingredients in required quantity as per the animal need and storage capacity, then mix all the micro-ingredients (e.g. LSP, Urea, Min. Mix, Salt, Jaggery and Water) separately and make slurry of it.
- Mix all the major ingredients (e.g. Maize, Cottonseed cake, Wheat bran) separately. Pour the slurry on major ingredients mixture and for homogenized mixture of all the ingredients then pour this homogenized material (1kg) into the rectangular mould of cattle biscuit machine. Fix the mould full of mixture on the machine and compress the material by rotating the spring rotator manually.

- Remove the compressed block (cattle biscuit) from mould. Feed the fresh block to the animal directly or store the as many blocks for further feeding as per need.



Advantages of Cattle Biscuit and Cattle Biscuit Machine

- The locally available feed resources can be used to make ration more economical. It enhances the bulk density of feeds—ultimately reduces storage space and transportation cost and also segregation of nutrients, over feeding is avoided.
- The rumen eco-friendly environment is established due to feeding of cattle biscuit.
- Further only single person can easily operate it with less operating space, it is light weighted and easily portable, no need of electricity as well.
- It also generates self-employments for unemployed youths.

Complete Feed Pelleting with Cotton Stalk Utilization Technology

- Complete feed system/total mixed ration is one of the approach to exploit the potential of animal feed resources in the best possible way. The complete feed is a quantitative mixture of all dietary ingredients formulated in desired proportion, blended together thoroughly to prevent separation and selection, fed as a sole source of nutrients. This feeding system allows expanded use of agro-industrial by-products, crop residues and non-conventional feeds in ruminant ration for maximizing production and minimizing feeding cost.
- The concentrate and roughage levels in complete feed system may varies as per different production purposes. The complete feed with the utilization of fibrous crop residue is practical way to increase the voluntary feed intake and thereby animal's production performance.
- In this system of feeding, the ruminant animals have continuous availability of complete feed mixture, resulting in more uniform rumen environment and converting it to complete feed pellet seems to be a promising method. However, pelleting of roughage and particularly hard crop residues like cotton stalk is very difficult due to low bulk density and post compression expansion during pelleting.
- Since the ruminants are reluctant to consume the cotton stalk, due to its hardness, therefore pelleting of such non palatable crop residues in pelleted complete feed may be the boon in overcoming the shortage of feed and fodder.



Preparation of complete pelleted feed

- The feed ingredients in complete feed such as cotton stalk (60%), cotton seed cake (15%), crushed maize (15%), arharchunni (8.5%) was formulated to form complete mash feed which is having optimum roughage to concentrate ratio and nutritive value fulfilling the nutritional requirements of goats.
- Then they are grinded in grinder and blended in mixer with the addition of mineral mixture (1%) and common salt (0.5%) The complete feed mixture was then adequately moistened by spraying water for purpose of pelleting using pellet machine.
- The in-vivo experiments revealed comparable body weights and better feed conversion efficiency with reduction in feed cost per kg body weight gain in goats.

Most leading constraint in sustainable development of livestock sector is availability of feeds and fodders both in quantitative and qualitative terms. It is well recognized that, effective utilization of non conventional crop residues as animal feed is an alternative way to overcome feed shortage for bulk eaters like ruminants. Apart from palatability and low bulk density, low nutritive value also restricts the utilization of crop residues as animal feed ingredients.

Cotton (*Gossypium spp.*) is naturally a perennial international crop plant that is now commercially cultivated by about 80 countries across the world. India is at top position by contributing largest under cotton crop cultivation measuring 33.23% of total area of the world. After harvesting the cotton crop, remaining biomass is highly rich in cellulose and hemicelluloses which are the crucial source of nutrients for the ruminant animals. The cotton plant residue (cotton straw) left after harvesting is mostly comprised of stalks and it has been estimated that nearly 2.5 to 3.5 tons of cotton stalks are generated per acre of cotton grown and that is mostly burnt away in the field. Such harvested cotton crop by-products has been useful as new non-conventional roughage resource in animal feeding. The primary challenge for use of cotton stalk biomass was the efficient, economic and sustainable design of pre-treatment in order to break and open the more complex ligno-cellulosic structure of cotton stalk facilitating the rumen enzymes and microbial access during ruminal degradation ultimately enhancing rate and yield of nutrients release.

Hence attempt was made in collaboration with IIT, Mumbai to treat these stalks with ozone gas, with a hypothesis that ozonolysis pre-treatment may degrade lignin with minimal effect on hemicelluloses and cellulose contents further enhancing susceptibility to cellulase enzyme hydrolysis and to digestion by rumen micro-organisms so that it can be used as ruminant feed. Ozone is one of the strongest oxidizing agents, soluble in water and readily available for use after its production from oxygen in a strongly endothermic reaction. Ozone reacts preferably with lignin than carbohydrates, promoting biomass destructure and delignification, and so the sugar release takes place by enzymatic hydrolysis, so that this could be potentially an effective method for pre-treating ligno-cellulosic biomass.



Procedure adopted for ozone treatment of cotton stalk

For the purpose of treatment, the freshly harvested cotton stalk was procured from the farmer's field of adjoining area and then chaffed in chaff cutter. Weighed 50 kg of chaffed cotton stalk was allowed to soak for overnight in about 500 litre of water in Sintex tank. On the next day, the soaked cotton stalk was given ozone treatment by bubbling method using ozone generator assembly for further 5 hours at 5 LPM pressure. The ozone generator assembly consisted of ozone converter, oxygen cylinder, Sintex tank and stand to assemble the unit. After completion of ozone treatment, the remaining water was drained and the ozone treated stalk was then allowed for sun drying till the moisture content was reduced to less than 15 percent. After sufficient drying, the ozone treated cotton stalk was used for the feeding of ruminants. The drained water was stored in cement tank and allowed to reuse for soaking of another cotton stalk.



In our studies the ozone treatment of cotton stalk revealed increased protein content by about 15 percent; increase in hemicellulose content by about 35 percent; increase in cellulose content by about 25 percent and reduction in lignin content by about 20 percent. This has indicated that more cellulose and hemicellulose are available for digestion, fermentation and thus increased the energy content of poor quality cotton stalk. The *in-vivo* studies in goats revealed that, inclusion of ozone treated cotton stalk could support body weight gain and better feed conversion efficiency, as more energy could have been made available due to breakdown of ligno-cellulosic bond and releasing more soluble fibre fraction for digestion and also by reducing lignin by ozone treatment. So this technology can be used to increase the nutritive value other waste crop residues such arhar stalk, safflower straw, groundnut haulms etc. which may be useful in feeding of ruminants and shall fill the gap of shortage of dry fodder in the country, particularly in Vidarbha and Marathwada region of Maharashtra State.

Anaerobic acidification technique to preserve green fodder

- Supply of Green forages throughout the year for the livestock is dwindling due to shrinkage of cultivable land, short supply of saplings and seeds of fodder crops and preference of cash crops over fodder crops by the farmers. Considering the shortage, Mumbai Veterinary College, Mumbai after exhaustive research, developed anaerobic acidification technique for preservation of green fodder.



- The crops with high soluble carbohydrate such as maize, sorghum and perennial grasses like Hybrid Napier, Gajraj, Yashwant, DHN 6 harvested at bloom stage are suitable for preservation with this technique.
- Moisture percentage of the fodder is reduced up-to 70% by sundrying for 12-14 hrs and the fodder is then chaffed. Intermittently the bacterial inoculums of *Lactobacillus plantrum* and *Lactobacillus acidophilus* are sprinkled over the fodder during pressing.
- The department has developed a special mechanized hydraulic press for efficient pressing within less time.
- Presences of inoculums prevent the growth of putrefactive bacteria and ensure lactic acid production/ reduction of pH in short time.
- The final Ph comes to 3.4 with the inoculums and the maturation time was reduced to 33 days as against 40 days with no inoculums.
- The technique is widely accepted and used by the farmers in the regions of the state where ample green fodder is available.



Model Retail Outlet for Production of Hygienic Chicken Meat

- Indian consumers generally prefer to purchase poultry meat from a retail market wherein birds are slaughtered in front of them. Unfortunately, at most of the un-organized retail shops, poultry processing procedures are carried out in a very unhygienic manner, exposing the consumers to the danger of acquiring food borne illness/infections.
- Considering the need, the hygienic and model chicken retail outlet has been developed by Department of Veterinary Public Health, Mumbai Veterinary College, Mumbai for hygienic dressing of chicken meat sale under ICAR-AICRP on Post Harvest Technology.

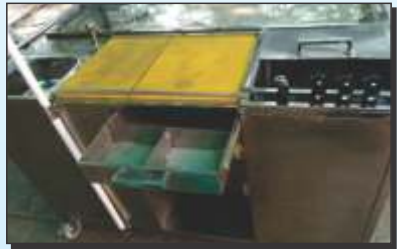


- Modern chicken outlet designed and developed by the centre is helpful in production of clean and hygienic meat that reduces the spread of the meat borne pathogens and hence disease outbreaks.
- The department has organized demonstrations and trainings for the butchers to increase the adaptability of model chicken retail outlet. The butchers have widely appreciated the design and many of them have adopted the outlet in Mumbai. One of the butcher M/s Babu Broilers report increase in the sale upto 40%.
- The University has applied for the patent of Model Chicken Retail Outlet.

- The majority of domestic markets are unhygienic and the fish storing and handling facilities are poor. Most of fish retailers sold their fishes on the roadside and un-hygienically manner. Fish retailers cannot utilize potable flowing water for washing and dressing fishes this may be chance of cross contamination of fishes with public heath bacteria.



- Considering this problem, Department of Fish Processing Technology, College of Fishery Science, Nagpur in April 2019 has developed movable hygienic fish selling unit with arrangement of display area with chilling facility by ice, storage space for fishes, hard chopping board for cutting and dressing of fishes, potable water storage tank, chlorinated water storage space for knife and chopper, waste collection Chamber, basin facility, drawers, stool, Umbrella for shadow, pushing handle and movable wheel for easy movement of unit. The overall dimensions of this unit are 120 x 90 x 90 cm. Several efforts were made to make this unit cost effective and affordable. The total cost incurred for fabrication of this unit is Rs. 40000/-. This mobile fish selling unit provides utmost importance for aqua food safety. Therefore, it makes sense for the aqua-food retail operators to be perceived as providing safe, quality aqua-food. Apart from this it also helps in minimizing post-harvest losses, increase revenue and offers high standards of hygiene and sanitation leading to food safety.



Movable sheep/ goat meat model retail shop design

→ Preparation of a design and layout drawing of a model retail shop.

As per the surveillance studies, conceptual designs of retail model outlet was (figures 10, 11 and 12).

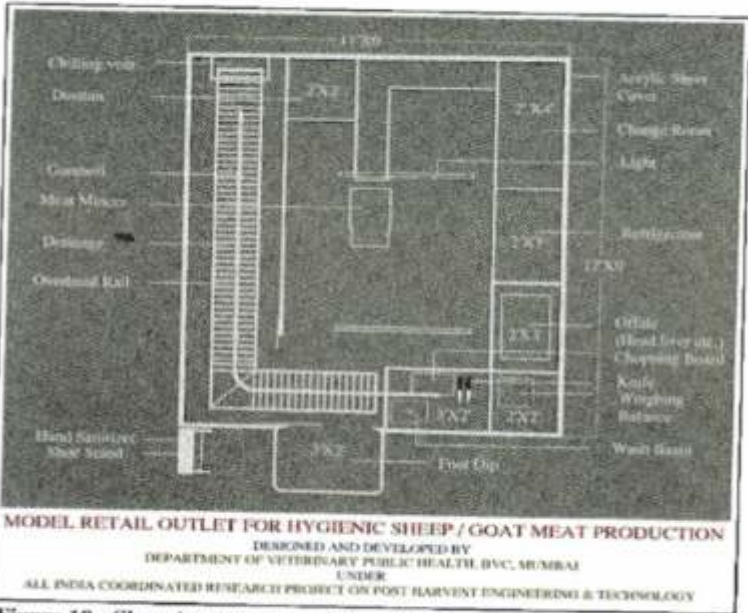


Figure 10 - Sheep/goat meat model retail outlet (Conceptual Design -2D)

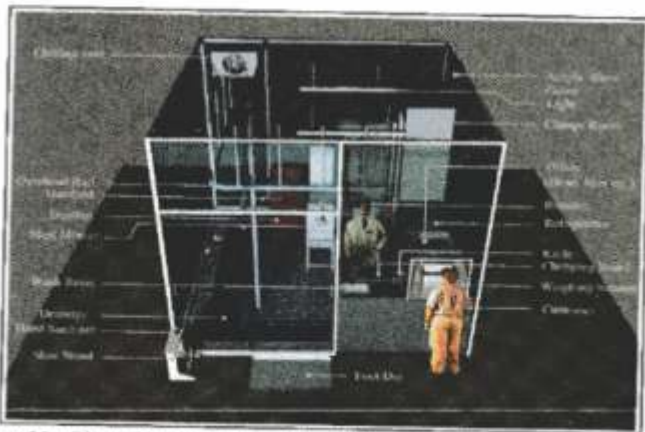


Figure 11 - Sheep/goat meat model retail outlet (Conceptual Design -3D)



Left view of movable retail outlet for hygienic Sheep/ Goat meat production



Front view of movable retail outlet for hygienic Sheep/ Goat meat production

- *Haemonchus contortus* is a highly pathogenic nematode parasite of gastrointestinal tract of goats. The adult worms usually attach to the fourth compartment of gastro-intestinal tract i.e., abomasum. Taking into consideration, the location and pH of the GI tract, a polyherbal anthelmintic tablet with a pH dependent polymer coating is formulated, which is safe, easy to administer and target specific which by passes the rumen, reticulum, omasum and disintegrate in abomasum only.



- “A pH Dependent Tablet” – A targeted polymer coated polyherbal anthelmintic tablet developed by Department of Veterinary Medicine, Nagpur Veterinary College, Nagpur has filed a patent application No.201821003488 on 30/01/2018. The publication date was 02/08/2019 and date of Examination filed is 01/07/2020.

- Housing is an important criterion for enhancement of the productivity of the animals.



- Besides providing the shelter, the housing should be cost effective and stress free under different climatic conditions.
- Considering the climatic conditions in the Maharashtra State, the Mumbai Veterinary College has developed a cost effective Loose Housing System for cattle, buffalo and goats of different age groups.
- The flooring, standing space, roofing material, fencing, manger and watering facilities have designed with low cost locally available material.
- Comparative data of heart rate, respiration rate, pulse rate, rumination time indicated that animals were more comfortable and stress free under loose housing.
- The housing system is immensely successful with the farmers in the State and the farmers have widely adopted the system.



- A Fly Proof Net Shed with Hurricane Ventilator has been developed for milking animals to avoid infestation from Dipteran pests of Livestock the Culicoides midges (Diptera: Ceratopogonidae). The Department of Parasitology, College of Veterinary and Animal Sciences, Parbhani has developed this Integrated Pest Management Module under the DBT sponsored project.



Fly Proof Net Shed

- The shed helps in increasing the milk production by minimizing the irritation and stress caused by flies.
- The project has been rated excellent by DBT.
- Farmers in Marathwada region are fast adopting the design of shed.

Preservation and Handling Techniques for Porcine Skin for Production of Biological bandages

- The process protocol to prepare the thin layered porcine skin graft and its preservation for further use as a biological dressing has been standardized.
- Porcine skin grafts can be converted into a biological dressing for treatment of burns or non-burn cases.



Buffalo Ear Treat the tracheal and cartilaginous tissue



Buffalo Tendon Treat



Buffalo Tracheal Treat



Patties from Emu Meat Sausage



Shelf stable fermented pork sausages using *Pediococcus Pentosaceus* and chemical acidulent (Gdl)

- It can also be used in treating soft-tissue wounds, surgical infections. Conclusively, finding indicates that PBS + 15% Glycerol appears to be suitable preservation medium for storage of porcine skin grafts.
- Porcine skin grafts are ready to undertake clinical trials on desired cases of animals.

- Value added Hot Extruded puffed product by incorporation of spent hen meat emulsion in the flour in various proportions has been developed by Department of Livestock Products Technology, Mumbai Veterinary College, Mumbai.



Re-hydrable shelf stable low sodium chicken strips

- A process for re-hydratable shelf stable low sodium chicken strips (LSCS) from spent hen meat to use in soups, curries, stews etc. was developed using hot air-drying technique (50°C) by Department of Livestock Products Technology, Mumbai Veterinary College, Mumbai.



Hot Extruded puffed chicken product

- In the era of WTO and open markets food safety and consumer protection assumes immense importance to compete the international players in the market.
- The food safety standards available are from developed countries like USA and European unions.
- After years of meticulous studies and exhaustive research the Department of Veterinary Public Health, Mumbai Veterinary College, Mumbai has formulated Microbial and Residues Standards in Indian scenario.

Name of food product	Total Viable Count	E. coli	S.aureus	Sulphide reducing Clostridia	Salmonella spp.
Fresh meat (before chilling)	$<10^6$	$<10^3$	$<10^3$	$<10^2$	Absent in 25 gm
Fresh chilled meat/ meat products	$<10^6$	$<10^3$	$<10^3$	$<10^2$	Absent in 25 gm
Frozen meat/ meat products	$<10^6$	$<10^3$	$<10^3$	$<10^2$	Absent in 25 gm
Processed meat (semi-cooked/ smoked)	$<10^6$	10^3	$<10^3$	$<10^2$	Absent in 25 gm

Standards for irradiation alone and in combination with chemical sanitizers for improvement of meat quality for export promotion

Treatment	Treatment
3 KGy radiation dose	~12 hrs at ambient storage ~15-19 days at refrigeration storage
Acid washing (1% propionic / 2% lactic/ 2% acetic) + 3 KGy radiation dose	~18 hrs at ambient storage ~21-28 days at refrigeration storage

Recommended irradiation doses

Food Product	Irradiation dose	Purpose
Meat and Meat Products including chicken	2.5 KGy (Minimum) 4.0 KGy (Maximum) 3.25 KGy (Overall average)	Shelf life extension and pathogen control

Standardize procedure for detecting pesticide residues in meat & egg.

- The procedure for detection of pesticides under the NABL scope of the Western Regional Referral Laboratory has been standardized in meat and meat products, chicken and eggs. These pesticides are: Alpha HCH, Beta HCH, Gamma HCH, Delta HCH, Aldrin, Alpha Endosulfan, P, P-DDE, Beta Endosulfan, P, P-DDD, Endosulfan Sulphate, P, P-DDT and Organophosphorous Pesticide: Chlorpyrifos.
- The Dept. of Veterinary Public Health, Mumbai Veterinary College, Mumbai has standardized and validated the test protocols for detection of pesticides and published the work in journals AOAC International (2002) 85, 6: 1398-1409 for Egg & AOAC International (2002) 85, 6: 1398-1409 & Food Engineering 79 (2007) 1110-1114.

- Department of Veterinary Microbiology, College of Veterinary & Animal Sciences Parbhani, under the ICAR Network Project on 'Blue Tongue Disease' after studying various outbreaks of Blue Tongue disease isolated 50 BTV from field and one of the isolate BTV-18 is named as Parbhani isolates.
- The department has conducted electron microscopic studies typing and molecular characterization of BTV.
- The isolate has been deposited at National Virus Repository, IVRI, Mukteswar. Sero-epidemiology of BT in the State has also been completed.
- Meteorological data of the microclimatic conditions of BT endemic areas has been analyzed and a disease forecasting model has been developed.
- A killed pentavalent BT vaccine has been developed under ICAR–Network Project. The technology has been transferred by ICAR for commercial production to Biovet, Bangalore and Indian Immunologicals, Hyderabad.
- ELISA for diagnosis of BT was also standardized and developed under the project.

16 Value Added Products from Milk

Preparation of Value Added Products like Chocolate flavour milk, Celebration chocolate packs, Chocolate burfi, KalakandBurfi, Khoa Cake, Khoa based chocolate Kaju roll etc.



Detection of Food-borne Pathogens by Loop Mediated Isothermal Amplification (LAMP) Technology

- The LAMP assay has been standardized for *S. aureus*, *Salmonella* spp. and *E.coli*. The Sensitivity of the LAMP assay was found (100 folds) than conventional PCR for *S. aureus* and *Salmonella* spp.
- LAMP could detect up-to 1.11×10^2 cfu/ml for both *stx1* and *stx2* genes of *E.coli*. Thus, sensitivity (detection limit) of the LAMP was found to be 10 folds greater than that of conventional PCR.
- The Specificity of LAMP and PCR assay for *S. aureus*, *Salmonella* spp. and *E.coli* was found to be 100%.
- The standardized LAMP technology can be recommended as cost effective, rapid and reliable test to detect *S. aureus*, *Salmonella* spp. and *E. coli* in foods of animal origin in resource limited laboratories at field level.

Standardized the process protocol for Extraction of Chondroitin Sulphate from Buffalo Cartilage

- Standardized the process protocol for Extraction of Chondroitin Sulphate from Buffalo Cartilage and is now ready for commercialization/adaptation by entrepreneurs/industries for medicinal and other purposes.



Bile concentrate and separation of Chondroitin sulphate extracted from acids and salts from bile tissue

- The Mumbai Veterinary College, Mumbai has applied for the patent application No. 201721004162/MUM/2017 dated 06/02/2017).

The process protocol for extraction of collagen from pig skin

- The process protocol for extraction of collagen from pig skin was developed and standardized using acid solubilized collagen (ASC) method.
- Collagen protein is extensively used in making health care products, food, cosmetics, medical materials, fodder, animal feed. Pig skin used for making collagen which will be beneficial to the traders by significant increase in the profit as the lard itself is sold at cheaper rate to the soap industries.
- This would be added advantage to the pig industries.

- National Recognition of Berari goat as 23rd Indian goat breed has been recognized by ICAR, New Delhi (Accession No. INDIA_GOAT_1100_BERARI_06023).
- IBDV virus isolated and its full genome sequencing was carried out and analysis found variant of other IBDV strains.
- Rotavirus gene sequences as GenBank MH769710–MH769747 (Total 38 DNA nucleotide sequences characterised and submitted to NCBI Genbank database). The strains were named as NAG/13, TDK/P, PBN/Q, C131_cattle, 129_RVA_Human, B1, 450. Three complete genome sequences of rotavirus strains were obtained and deposited in database.
- New pathogenic *Bacillus anthracis* COVASU strain established.
- Identified *Bacillus cereus* (CWBI-B1082) strain as novel bio-pesticide agent against larvae of *Culicoides* spp. in drainage channels. The bacterium is already used in food fermentations and probiotic formulations, and hence appears to be safe. Further research trials are being undertaken to assess its efficacy under field condition.
- Detected *Theileria orientalis* and *Babesia bovis* by PCR for the first time in Maharashtra in the BBSRC DBT project on "Molecular epidemiology of ticks and tick borne disease, host resistance and development of novel pathogen vaccines"
- New vector identified in Mite species "*Ornithonyssus bacotii*" (tropical rat mite) with potentials to transmit *Orientia tsutsugamushi* an etiological agent for Scrub typhus in the region.
- Bacteria from the new species domain: A multidrug-resistant
- *Leclercia* species from animal clinical case has been identified for the first time
- New Host: Isolates of *Listeria monocytogenes* have been obtained from hairy caterpillar, fly, tick as a new host species out of thesis work.
- The rabies virus from Dog brain samples confirmed by G gene PCR and sequencing. Obtained NCBI accession numbers.

Milk based ELISA for the detection of *L. monocytogenes*

- Milk based ELISA has been developed and standardized for the detection of *L. monocytogenes* in bovines. The test is sensitive and specific.
- The test will help the entrepreneur to declare that milk is free from *L. monocytogenes*, a food borne pathogen.

Antigen capture Sandwich ELISA for the detection of *Pasteurellamultocida* directly from poultry clinical samples.

- Antigen capture Sandwich ELISA for the detection of *Pasteurellamultocida* directly from clinical samples can provide diagnosis of fowl cholera. Highly sensitive and specific in comparison to cultural examination. This technique will enable to diagnose fowl cholera from the clinical samples like tissue and intestinal content within few hours.

PCR for detection and characterization of *Pasteurellamultocida* from formalin fixed tissue

- Technique has been standardized to detect and characterized *Pasteurellamultocida* from formalin fixed tissue as a diagnostic tool.
- Technique has been found to be sensitive and specific. It is innovative as formalin preserved tissue can be employed for diagnosis

Diagnostic PCR for Classical swine fever virus

- Technique has been standardized to detect and characterize the Classical swine fever virus from tissue under DBT sponsored research project.
- Technique has been found to be sensitive and specific. It is in house standardized and can be employed for diagnosis.

Duplex PCR for simultaneous diagnosis of Tuberculosis and Brucellosis

- The test has been standardized for quick diagnosis of tuberculosis and brucellosis through duplex PCR under the ICAR, NAE-Project on Centre for Zoonoses.

Listeriolysin - O (LLO) based ELISA has been developed for serodiagnosis of listeriosis

- The test has been standardized for carrying out sero diagnosis of listeriosis under the ICAR NAE-Project on Centre for Zoonoses from serum samples.

Alternative material for sample collection for diagnosis of PPR in resource limited setup

- The use of filter paper/news paper for sample collection (nasal secretions) of animal for diagnosis of PPR has been standardized.

Development of ELISA kit for Diagnosis of Hydatidosis in Cattle

- Standardized indirect ELISA kit by standard protocol of checker board titration method and validated the kit from different veterinary colleges. The Sensitivity and Specificity of the kit is 95.4% and 92.21% respectively. The college has applied for the patent.

- Use of Self polymerizing powder commonly used for preparation of denture is recommended for application of hoof block for the treatment of severe sole ulcer and punctured sole in cattle under field conditions.
- First report on the use of bio-fungal agent *Verticilliumlecanii* against tropical cattle tick, *Rhipicephalusmicroplus*(Acarina: ixodidae).
- Standardized the **technology for packaging of hard boiled eggs** using Cryovac packaging material along with gas mixture of 80% CO_2 + 20% N_2 for storage at refrigeration temperature (0–4°C) as it showed extension of shelf-life of eggs up to 30 days than ordinary packaged eggs.
- standardized the **technology for packaging of buffalo and goat meat** using modified atmosphere packaging with Evoc or Nylon base or Cryovac packaging material and any gas mixture of 70 % O_2 + 20 % CO_2 + 10 % N_2 or 80% O_2 + 20% CO_2 , for storage at refrigeration temperature as it showed extension of shelf- life of buffalo and goat meat up to 9 and 13 days, respectively than ordinary packaging (3–5 days).
- Under the State Govt. Sponsored mineral assessment project the university through its constituent colleges **generated database of mineral, soil, fodder and animal relationship district-wise in Maharashtra state**. On the basis of database district-wise area specific mineral mixture for 33 districts of state are recommended.
- College of Fishery Sciences, Nagpur has **standardized the Cage rearing technique for fish fingerlings** under the RGSTC project Demonstration and Training of Fish stock Enhancement of Small Reservoirs of the Vidarbha and Marathwada Region of Maharashtra. The technique helps in increasing the fish production considerably.
- College of Dairy Technology, Warud has developed and **standardized the process protocol for preparation of SantraBarfi** under the RGSTC project Rheological Behaviour and Modelling of Sorption Kinetics of Traditional Dairy Products. The technique is ready for commercialization.



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