



वार्षिक प्रतिवेदन ANNUAL REPORT 2017-18

भा.कृ.अनु.प. - राष्ट्रीय माँस अनुसंधान केंद्र
ICAR - National Research Centre on Meat

Chengicherla, Boduppal Post, Hyderabad - 500092

ISO 9001:2015 Certified Organization





ANNUAL REPORT

2017-18



ICAR -NATIONAL RESEARCH CENTRE ON MEAT

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Correct Citation : Annual Report 2017-18
ICAR-National Research Centre on Meat
Chengicherla, Boduppal Post
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PREFACE



I am pleased to present the Annual Report of ICAR-National Research Centre on Meat for the year 2017-18. The year, 2017-18 was very fruitful for the Institute. The Institute has a number of achievements in terms of research and infrastructure development.

With scientific innovations and technological advancements, the field of food in general and meat in particular, has witnessed some revolutionary changes which have been primarily consumer directed as food production and processing are highly consumer sensitive domains.

Due to the nutritional importance and the sustained popularity of meat as a foodstuff, the livestock production sector has been expanding incessantly. This exponential growth of meat sector poses a gigantic challenge to the

sustainability of food production system.

The Institute has submitted proposal for NABL accreditation of its facility for meat speciation. Periodically, the Institute is receiving samples from all over India for meat species identification. In its endeavor, the Institute has procured sophisticated equipment namely, the ddPCR for sensitive detection of the adulterated meat. We have established protocols for meat species identification for mutton, chevon, pork, buffalo meat, camel meat in meat mixtures. The Institute will expand its domain in this core area.

The NRCM-agri-business incubator inaugurated in 2016 has been doing well and organizing various skill development programmes, providing incubation facilities and technical know-how to prospective entrepreneurs.



Angiotensin Converting Enzyme (ACE) inhibitory peptides/hydrolysates has been extracted from buffalo liver and found to have significantly higher inhibitory activity for trypsin, pepsin and pronase-E hydrolysed buffalo liver sample relative to control.

We are working to develop tissue specific assays for meat speciation. Micro-RNA extraction from three different tissues of chicken like liver, heart and gizzard was carried out using two different protocols. The Institute is working on a on package strip type sensor developed by coating Ag NP, TiO₂ and anthocyanin onto nitrocellulose membrane which changes color from dark pink to pale whitish pink as the quality of chicken meat deteriorates during refrigerated storage. The Institute has also standardized protocols for detection of antibiotic residues in meat.

A superchilling cabinet has been designed and fabricated with respect to temperature and humidity to optimize the superchilling condition of dressed carcass or meat in order to improve its quality and storage stability. The Institute has demonstrated a traceability model in the buffalo meat-value chain, mainly for use in export abattoirs. Also developed prototype of AL - LAMP kit for identification and differentiation of cattle and buffalo meats.

The Institute has completed organic certification for fodder and sheep are being reared organic way. Supplementation of seleno-methionine at the rate of 500 ppb in the diets of Nellore brown ram lambs was found to be optimal for effective incorporation of selenium into meat and edible organs. The Institute has also initiated a programme on assessment of occupational hazards among abattoir associated personnel.

Buffalo meat production and export had positive effect on buffalo population and productivity and there were no adverse effects on draught animal power requirements and ecobalance contributing towards sustainable buffalo production.

Regular interactions and awareness programmes are being arranged in various parts of Hyderabad city through "Meat on Wheels". The Institute has organized five awareness and training programmes for different stakeholders of sheep and goat value chain under National Livestock Mission programme. Seven MoUs were signed with entrepreneurs for establishment of slaughterhouse and value added meat products processing units. The Institute had successfully conducted short term training programme sponsored by MANAGE.

I appreciate the solemn efforts of the editorial team for bringing out this Annual Report.

I candidly acknowledge the support of all the staff of NRC on Meat, Hon. Director General, ICAR, Deputy Director General (Animal Sciences), Assistant Director General (AN and P) and Principal Scientists at the Animal Science Division of ICAR. I acknowledge the RAC and IMC members for their suggestions. The Institute invites suggestions from scientific fraternity and stake holders to improve its worthiness.

S. Vaithyanathan
Acting Director

प्रस्तावना

मुझे वर्ष 2017-18 की आईसीएआर- राष्ट्रीय मांस अनुसंधान केंद्र की वार्षिक प्रतिवेदन पेश करने में प्रसन्नता हो रही है। वर्ष 2017-18 संस्थान के लिए बहुत उपयोगी रहा। अनुसंधान और बुनियादी ढांचे के विकास के मामले में संस्थान ने कई उपलब्धियां हासिल की हैं।

वैज्ञानिक नवाचारों और तकनीकी प्रगति के साथ, सामान्य रूप से भोजन और विशेष रूप से मांस के क्षेत्र में कुछ क्रांतिकारी परिवर्तन हुए हैं, जो प्राथमिक रूप से उपभोक्ता निर्देशित है क्यों कि खाद्य उत्पादन और प्रसंस्करण उपभोक्ता संवेदनशील डोमेन है।

पौष्टिकता का महत्व और खाद्य पदार्थों के रूप में मांस की निरंतर लोकप्रियता के कारण, पशुधन उत्पादन क्षेत्र निरंतर विस्तार कर रहा है। पशुधन मांस क्षेत्र की घातीय वृद्धि खाद्य उत्पादन प्रणाली की स्थिरता के लिए एक बड़ी चुनौती बन गई है।

संस्थान ने मांस की पहचान के लिए अपनी सुविधा के एनएबीएल प्रमाणीकरण के प्रस्ताव को प्रस्तुत किया है। संस्थान मांस प्रजातियों की पहचान के लिए पूरे भारत से नमूने प्राप्त कर रहा है। अपने प्रयास में, संस्थान ने व्युत्पन्न मांस की संवेदनशील पहचान के लिए डीडीपीसीआर उपकरण प्राप्त किया है। हमने मांस मिश्रणों में मटन, शेवन, पोर्क, भैंस मांस, ऊंट मांस के पहचान के लिए प्रोटोकॉल स्थापित किए हैं। संस्थान इस प्रमुख क्षेत्र में अपने डोमेन का विस्तार करेगा। 2016 में उद्घाटित संस्थान का कृषि-व्यवसाय इनक्यूबेटर अच्छी तरह से कार्य कर रहा है और विभिन्न कौशल विकास कार्यक्रमों का आयोजन कर रहा है, जो संभावित उद्यमियों को इनक्यूबेटर सुविधाएं और तकनीकी जानकारी प्रदान करता है।

संस्थान ने भैंस के यकृत से एंजियोटेंसिन कनवर्टिंग एंजाइम (एसीई) अवरोधक पेप्टाइड्स / हाइड्रोलिसेट्स की पहचान की है और नियंत्रण के सापेक्ष ट्राप्सिन, पेप्सीन और प्रवण-ई हाइड्रोलाइज्ड भैंस यकृत नमूने के लिए काफी अधिक अवरोधक गतिविधि पायी गई है।

हम मांस की पहचान के लिए उतक विशिष्ट प्रणाली विकसित करने के लिए काम कर रहे हैं। यकृत, दिल और गिजार्ड जैसे चिकन के तीन अलग-अलग ऊतकों से सूक्ष्म आरएनए निष्कर्षण दो अलग-अलग प्रोटोकॉल का उपयोग करके किया गया है। यह संस्थान नाइट्रोसेल्यूलोस झिल्ली पर एजी एनपी, टीओओ 2 और एंथोसाइनिन कोटिंग द्वारा विकसित पैकेज स्ट्रिप टाइप सेंसर पर काम कर रहा है जो रेफ्रिजरेटेड स्टोरेज के दौरान चिकन मांस की गुणवत्ता के कारण गहरे गुलाबी से पीले सफेद गुलाबी रंग में बदलता है। संस्थान ने मांस में एंटीबायोटिक अवशेषों का पता लगाने के लिए प्रोटोकॉल को मानकीकृत किया है।

हमने गुणवत्ता और भंडारण स्थिरता में सुधार के लिए तैयार चिकन या मांस की सुपरचिलिंग स्थिति को अनुकूलित करने के लिए तापमान और आर्द्रता के संबंध में एक सुपरचिलिंग कैबिनेट विकसित किया है। संस्थान ने भैंस मांस-मूल्य श्रृंखला में मुख्य रूप से निर्यात बूचड़खानों में उपयोग के लिए एक पशुधन पता लगाने की क्षमता के मॉडल का प्रदर्शन किया है। मवेशी और भैंस मांस की पहचान और भेद के लिए एएल - लैप किट का प्रोटोटाइप भी विकसित किया गया।



संस्थान ने हरा चारे के लिए जैविक प्रमाणन पूरा कर लिया है और भेड़ को जैविक तरीके से पालन किया जा रहा है। नेल्लोर ब्राउन रैम भेड़ के आहार में 500 पीपीबी की दर से सेलेनो-मेथियोनीन का पूरक मांस और खाद्य अंगों में सेलेनियम के प्रभावी निगमन के लिए इष्टतम पाया गया था। संस्थान ने बूचड़खानों संबंधित कर्मियों के बीच व्यावसायिक खतरों के आकलन पर भी एक कार्यक्रम शुरू किया है।

हैदराबाद शहर के विभिन्न हिस्सों में "मीट ऑन व्हील्स" के माध्यम से जागरूकता और नियमित बातचीत कार्यक्रम आयोजित किए जा रहे हैं। संस्थान ने राष्ट्रीय पशुधन मिशन कार्यक्रम के तहत भेड़ और बकरी मूल्य श्रृंखला के विभिन्न हितधारकों के लिए पांच जागरूकता और प्रशिक्षण कार्यक्रम आयोजित किए हैं। बूचड़खानों और मूल्यवर्धित मांस उत्पादों की प्रसंस्करण इकाइयों की स्थापना के लिए उद्यमियों के साथ सात समझौता ज्ञापनों पर हस्ताक्षर किए गए। संस्थान ने मैनेज द्वारा प्रायोजित अल्पकालिक प्रशिक्षण कार्यक्रम सफलतापूर्वक आयोजित किया था।

मैं इस वार्षिक रिपोर्ट को लाने के लिए संपादकीय टीम के गंभीर प्रयासों की सराहना करता हूँ। मैं स्पष्ट रूप से माननीय महानिदेशक, आईसीएआर, उप महानिदेशक (पशु विज्ञान), सहायक महानिदेशक (एएन और पी), आईसीएआर के पशु विज्ञान प्रभाग में प्रधान वैज्ञानिक और संस्थान के सभी कर्मचारियों का आभार प्रकट करता हूँ। मैं सुझावों के लिए अनुसंधान सलाहकार समिति और संस्थान प्रबंधन समिति के सदस्यों प्रति आभार प्रकट करता हूँ। संस्थान अपनी योग्यता में सुधार के लिए वैज्ञानिक बंधु और हितधारकों से सुझाव आमंत्रित करता है।

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कार्यकारी निदेशक

EXECUTIVE SUMMARY

With its mission to develop modern, organised meat sector through meat production, processing and utilization technologies, ICAR - National Research Centre on Meat, Hyderabad has undertaken various activities related to meat sector. The Institute has undertaken various research initiatives, contract research, skill development and entrepreneurship development programmes. The Institute also organized workshops, stake-holders meetings, participated in exhibitions, signed MoU/agreements and conducted various other activities. During the period from April 2017 to March 2018 two new extramural projects were sanctioned and implemented. The Institute installed droplet digital PCR machine. The Institute had interactions with various agencies and development departments to promote clean and hygienic meat production, value addition and to discuss strategies for doubling the farmers' income. The Institute had successfully conducted one MANAGE sponsored short term training programme, organized 2 training programmes on clean meat production and five paid trainings on value added meat products and 61 entrepreneurs were given hands on training on value added meat products processing. Seven MoUs were signed with entrepreneurs for establishment of slaughterhouses and value added meat products processing units.

The summary of the Institute activities during the period from April 2017 to March 2018 is presented below:

Research and development

- *In-vitro* digested protein hydrolysates were purified using gel filtration chromatography and characterized using MALDI-TOF mass spectrometry analysis. Angiotensin Converting Enzyme (ACE) inhibitory peptides/hydrolysates from buffalo liver were extracted, purified and evaluated for *in-vitro* activity and found to have significantly higher inhibitory activity for trypsin, pepsin and pronase-E hydrolysed buffalo liver sample relative to control.
- On package strip type sensor developed by coating Ag NP, TiO₂ and anthocyanin onto nitrocellulose membrane changed colour from dark pink to pale whitish pink as the quality of chicken meat deteriorated during refrigerated storage. Comparison of quality changes of chicken meat with color change in the strip-type sensor indicated that the color of the sensor corroborated with the meat quality during refrigerated storage.
- Superchilling conditions were standardized for dressed broiler chicken and meat cuts. Physico chemical properties of meat under chilling, freezing and superchilling conditions were analysed. WHC, cooking yield, shear force were significantly decreased throughout the storage period, whereas, TBA value and percent metmyoglobin were significantly increased.
- Developed draft outlines for implementation of livestock traceability in India and presented to officials of APEDA regarding its implementation in two meetings.



- Developed prototype of AL- LAMP kit for identification and differentiation of cattle and buffalo meats.
- Micro RNA extraction from three different tissues of chicken, viz., liver, heart and gizzard was carried out using two different protocols.
- Organic certification for the fodder has been completed. Sheep are being reared under organic management. External auditing of organic sheep unit by APEDA accredited certifying agency One Cert Asia has been completed.
- Simultaneous determination of enrofloxacin and ciprofloxacin in meat samples was standardized. The RP-HPLC analysis of about 270 buffalo meat samples was done, six samples were found to be positive and their levels were in compliance with Codex MRL.
- Taqman assay using cattle and buffalo specific probes was developed to quantitatively detect tallow in the ghee/tallow binary mixture. The Taqman assay has been validated in the commercial tallow samples. NABL accreditation of meat speciation laboratory is under progress.
- Established protocols for meat species identification for mutton, chevon, pork, buffalo meat, camel meat in meat mixtures. Meat samples were analysed using LCD meat array and found 44 out of 89 Haleem samples misrepresented. A total number of 47 forensic samples have been analyzed for meat species in 2017-18.
- The questionnaires for collection of the data from abattoir associated personnel have been designed. A total 91 serum samples were collected from occupationally exposed individuals. Data on personal hygiene and epidemiological data have also been collected.
- High prevalence of *Salmonella* and *E. coli* in meat samples exhibiting multiple drug resistance was noticed.
- Development of ozone based carcass decontamination technology is under progress.
- Supplementation of seleno-methionine at the rate of 500 ppb in the diets of Nellore brown ram lambs was optimal for effective incorporation of selenium into meat and edible organs.
- The ddPCR machine has been installed and few experiments using DNA from milk fat/animal body fat/vegetable fat have been done.
- Among the technologies developed by the institute, emulsion technology showed medium technology spread index of 4.92 compared to other technologies with low index of 1.
- Buffalo meat production and export had positive effect on buffalo population and productivity and there were no adverse effects on draught animal power requirements and ecobalance contributing towards sustainable buffalo production.

Training, workshop and extension activities

- Five awareness and training programmes were conducted for different stakeholders of sheep and goat value chain under National Livestock Mission programme.

- Training programme on Entrepreneurship Development in Meat Value Chain was organized in collaboration with MANAGE.

MoUs and consultancy

- Seven MoUs were signed with entrepreneurs for establishment of slaughterhouse and value added meat products processing units.

Institutional activities and distinguished visitors

- IRC, RAC, and IMC meetings were conducted to review the achievements and progress of the Institute.
- International Yoga Day, World Zoonoses Day, Independence Day, Vigilance Awareness Week, Hindi Diwas, Republic day, Institute foundation day, Swachhta Pakhwada were celebrated.
- As a part of 'Swachh Bharat Mission', massive cleaning programmes were carried out throughout the year.
- Several dignitaries including Dr. Trilochan Mohapatra, Hon. Secretary, DARE and Director General, ICAR, Dr. Joykrushna Jena, DDG (AS), ICAR, Shri NVSS Prabhakar, Hon. MLA Uppal, Dr. M. Srinivas Reddy, Hon. MLC, Govt. of Telangana, Mrs. V. Usha Rani, Director General, MANAGE, Hyderabad, Shri Suresh Chanda, Special Chief Secretary, Govt. of Telangana and various other dignitaries / experts visited the Institute.

विशिष्ट सारांश

मांस उत्पादन, प्रसंस्करण और उपयोगी प्रौद्योगिकियों के माध्यम से आधुनिक, संगठित मांस क्षेत्र विकसित करने के अपने मिशन के साथ, राष्ट्रीय मांस अनुसंधान केंद्र, हैदराबाद ने मांस क्षेत्र से संबंधित विभिन्न गतिविधियां शुरू की हैं। संस्थान ने विभिन्न अनुसंधान पहल, अनुबंध अनुसंधान, कौशल विकास और उद्यमिता विकास कार्यक्रम शुरू किए हैं। संस्थान ने कार्यशालाओं, हितधारकों की बैठकों का आयोजन किया, प्रदर्शनियों में भाग लिया, समझौता ज्ञापन (एमओयू)/समझौतों पर हस्ताक्षर किए और विभिन्न अन्य गतिविधियों का आयोजन किया। अप्रैल 2017 से मार्च 2018 की अवधि के दौरान दो नई निकासी परियोजनाओं को मंजूरी दे दी गई और कार्यान्वित किया गया। संस्थान ने बूंद डिजिटल पीसीआर मशीन स्थापित की। स्वच्छ मांस उत्पादन, मूल्यवर्धन और किसानों की आय को दोगुना करने के लिए रणनीतियों पर चर्चा करने के लिए संस्थान ने विभिन्न एजेंसियों और विकास विभागों के साथ बातचीत की। संस्थान ने एक मैनेज प्रायोजित अल्पकालिक पाठ्यक्रम कार्यक्रम सफलतापूर्वक आयोजित किया था। स्वच्छ मांस उत्पादन पर 2 प्रशिक्षण कार्यक्रम आयोजित किए थे और मूल्य वर्धित मांस उत्पादों की प्रसंस्करण पर पांच भुगतान प्रशिक्षण कार्यक्रम आयोजित किए और 61 उद्यमियों को मूल्य वर्धित मांस उत्पादों की प्रसंस्करण पर व्यक्तिगत प्रशिक्षण दिए। बूचड़खानों और मूल्य वर्धित मांस उत्पाद प्रसंस्करण इकाई की स्थापना के लिए उद्यमियों के साथ सात समझौता ज्ञापनों पर हस्ताक्षर किए गए।

अप्रैल 2017 से मार्च 2018 की अवधि के दौरान संस्थान की गतिविधियों का सारांश नीचे प्रस्तुत किया गया है:

वृत्ति/कृति/वृत्ति/वृत्ति

- कृत्रिम परिवेशीय पचाये हुए प्रोटीन हाइड्रोलाइसेट्स को जेल निस्पंदन क्रोमैटोग्राफी का उपयोग करके शुद्ध किया गया और मालदी टोफ द्रव्यमान स्पेक्ट्रोमेट्री विश्लेषण का उपयोग करके विशेषताओं का पता लगाया गया। एंजियोटेंसिन कनवर्टिंग एंजाइम (एसीई) अवरोधक पेप्टाइड्स/भैंस यकृत से हाइड्रोलाइजेट इन-विट्रो गतिविधि से शुद्ध और मूल्यांकन किए गए थे और नियंत्रण के सापेक्ष ट्राप्सिन, पेप्सीन और **pronase**—ई हाइड्रोलाइज्ड भैंस यकृत नमूने के लिए काफी अधिक अवरोधक गतिविधि पायी गयी।
- नाइट्रोसेल्यूलोस झिल्ली पर एजी एनपी, टीओओ 2 और एंथोसाइनिन कोटिंग द्वारा विकसित पैकेज स्ट्रिप प्रकार सेंसर प्रशीतन भंडारण के दौरान चिकन मांस की गुणवत्ता खराब होने के कारण काले गुलाबी से पीला सफेद गुलाबी रंग बदल जाता है। स्ट्रिप—प्रकार सेंसर में रंग परिवर्तन के साथ चिकन मांस के गुणवत्ता में परिवर्तन की तुलना से संकेत मिलता है।
- अपनी गुणवत्ता और भंडारण स्थिरता में सुधार के लिए तैयार चिकन या मांस की सुपरचिलिंग स्थिति को अनुकूलित करने के लिए तापमान और आर्द्रता के संबंध में एक सुपरचिलिंग कैबिनेट विकसित किया गया है। डब्ल्यूएचसी, खाना पकाने की उपज, कतरनी बल भंडारण अवधि में काफी कमी हो गयी, जबकि, टीबीए मूल्य और प्रतिशत मेटमायोग्लोबिन में काफी वृद्धि हुई थी।
- भारत में पशुधन ट्रेसिबिलिटी के कार्यान्वयन के लिए ड्राफ्ट रूपरेखा विकसित की गयी और दो बैठकों में इसके कार्यान्वयन के संबंध में एपीडा के अधिकारियों की समक्ष प्रस्तुत किया गया।



- मवेशी और भैंस मांस की पहचान और भेद के लिए एएल – लैप किट का प्रोटोटाइप विकसित किया गया।
- चिकन के तीन अलग-अलग ऊतकों से सूक्ष्म आरएनए निष्कर्षण, जैसे जिगर, दिल और गिजार्ड, दो अलग-अलग प्रोटोकॉल का उपयोग करके किया गया है। अलग सूक्ष्म आरएनए के लिए सीडीएनए संश्लेषण किया गया था और आरटी-पीसीआर प्रगति पर है।
- हरा चारा हेतु जैविक सत्यापन पूरा हो चुका है। भेड़ों को जैविक प्रबंधन के अंतर्गत पाला जा रहा है। जैविक भेड़ इकाई का अंकेषण एपीडा द्वारा मान्य बाहरी ऑडिटिंग एजेंसी वनसर्ट एशिया द्वारा पूरा हो चुका है।
- मांस नमूनों में एनरोप्लोक्सासिन और सिप्रोफ्लोक्सासिन की साथ-साथ पहचान मानकीकृत की गयी। लगभग 270 भैंस मांस के नमूने आरपी-एचपीएलसी विश्लेषण किए गए थे, छह नमूने सकारात्मक पाए गए थे और उनके स्तर कोडेक्स एमआरएल से कम थे।
- मवेशी और भैंस विशिष्ट जांच ताकमैन परख का उपयोग करके घी/वसाका दोहरा मिश्रण में मात्रात्मक रूप से लम्बाई का पता लगाया गया। वाणिज्यिक वसा नमूनों में ताकमैन परख मान्य किया गया है।
- हमने मांस मिश्रणों में मटन, शेवन, पोर्क, भैंस मांस, ऊंट मांस के लिए मांस प्रजातियों की पहचान के लिए प्रोटोकॉल स्थापित किए हैं। हमने एलसीडी मांस सरणी का उपयोग करके मांस के नमूनों का परीक्षण किया है और 89 नमूनों (हलीम) में से 44 नमूने गलत तरीके से प्रस्तुत किए गए थे। 2017-18 में मांस प्रजातियों का विश्लेषण के लिए 47 फॉरेंसिक नमूने प्राप्त किये थे।
- एनएबीएल (NABL) प्रमाणीकरण हेतु आवेदन की तैयारी एवं जमा करने की प्रक्रिया मान्यता प्रत्यापन हेतु कार्य प्रगति पर है।
- कसाईखाने से संबंधित कर्मियों की जानकारी एकत्र करने के लिए प्रश्नावली तैयार की गई हैं। व्यक्तिगत स्वच्छता पर आधारित सामग्री और महामारी विज्ञान पर आधारित सामग्री भी एकत्रित की गयी है। ब्रुसेलसिस के खिलाफ प्रतिरक्षी के लिए कुल 5 (5.49%) नमूने सकारात्मक थे।
- मांस नमूनों में साल्मोनेला और ई कोलाई का उच्च प्रसार तथा दवा प्रतिरोध देखा गया है।
- नेल्लोर ब्राउन रैम भेड़ के आहार में 500 पीपीबी की दर से सेलेनो-मेथियोनीन का पूरक मांस और खाद्य अंगों में सेलेनियम के प्रभावी निगमन के लिए इष्टतम था।
- डीडीपीसीआर मशीन स्थापित की गई है और दूध वसा/पशुशरीर वसा/सब्जियों की वसा से डीएनए का उपयोग कर के कुछ प्रयोग किए गए हैं।
- संस्थान द्वारा विकसित प्रौद्योगिकियों में, इमल्शन प्रौद्योगिकी ने कम इंडेक्सवाली अन्य प्रौद्योगिकियों की तुलना में 4.92 की मध्यम प्रौद्योगिकी प्रसार सूचकांक दिखायी।
- भैंस मांस उत्पादन और निर्यात का भैंस आबादी और उत्पादकता पर सकारात्मक प्रभाव पड़ा और सतत भैंस उत्पादन की दिशा में पशुऊर्जा आवश्यकताओं और पर्यावरणीय योगदान पर कोई प्रतिकूल प्रभाव नहीं पड़ा।

८'k{k.k] dk;!kkyk vkj foLrkj xfrfof/k;k

- राष्ट्रीय पशुधन मिशन कार्यक्रम के तहत भेड़ और बकरी मूल्य श्रृंखला के विभिन्न हित धारकों के लिए पांच जागरूकता और प्रशिक्षण कार्यक्रम आयोजित किए गए।

le>krk Kkiu vkj i jke'ki

- बूचड़खानों और मूल्यवर्धित मांस उत्पाद प्रसंस्करण इकाई की स्थापना के लिए उद्यमियों के साथ सात समझौता ज्ञापनों पर हस्ताक्षर किए गए ।

lLFkkxr xfrfof/k;k vkj çfrf"Br vkr|d

- संस्थान की उपलब्धियों और प्रगति की समीक्षा के लिए संस्थान अनुसंधान परिषद, अनुसंधान सलाहकार समिति और संस्थान प्रबंधन समिति की बैठकें आयोजित की गईं।
- अंतर्राष्ट्रीय योग दिवस, विश्व जूनोसेस दिवस, स्वतंत्रता दिवस, सतर्कता जागरूकता सप्ताह, हिंदी दिवस , गणतंत्र दिवस, संस्थान स्थापना दिवस, स्वच्छता पखवाड़ा मनाये गए।
- 'स्वच्छ भारत मिशन' के एक हिस्से के रूप में, पूरे साल बड़े पैमाने पर सफाई कार्यक्रम चलाए गए।
- डॉ. त्रिलोचन महापात्र, माननीय सचिव, कृषि अनुसंधान और शिक्षा विभाग और महानिदेशक, आईसीएआर, डॉ. जॉयकृष्ण जेना, उप महानिदेशक (एएस), आईसीएआर, श्री एनवीएसएस प्रभाकर, माननीय विधायक, उप्पल, डॉ. एम. श्रीनिवास रेड्डी, माननीय एमएलसी, तेलंगाना सरकार, श्रीमती वी उषा रानी, महानिदेशक, मैनेज, हैदराबाद, श्री सुरेश चंदा, विशेष मुख्य सचिव, तेलंगाना सरकार और कई अन्य विशेषज्ञों सहित कई गणमान्य व्यक्तियों ने संस्थान का दौरा किया।

INTRODUCTION

India has a vast livestock wealth and ranked 1st, 2nd, 3rd, and 4th in the world for water buffalo, cattle, goat, and sheep numbers, respectively. India is producing the largest amount of buffalo meat in the world (43.33% of total) and also the world's 3rd largest producer of goat meat. The frozen buffalo meat and byproducts is the single largest agricultural commodity exported from India. Per capita consumption of meat in India remains relatively low, less than 5.5 kg/person/year.

The 65 export abattoirs-cum-meat-processing plants in India registered with the Agricultural and Processed Food Products Export Development Authority (APEDA) employ about 74,000 individuals directly and 150,000 individuals indirectly. India is exporting meat and meat byproducts to 85 countries around the world. India's poultry sector represents one of the biggest success stories of the country over the past decade. Poultry meat is mostly sold by slaughtering live birds in the presence of consumers in wet markets, and this comprises almost 91% of total broilers. The demand for chilled and frozen poultry meat, and portioned cuts, has been increasing in the recent years. This has resulted in more than 21 modern poultry-processing plants with a capacity to process about 1000 to 6000 birds per hour.

The ready-to-eat meat sector is growing with consumer affluence. However, processing and value addition of meat in India remain less than 2% with the exception of poultry, where about 7.2% of meat undergoes processing. The availability of cheaper, durable, and simple meat-processing machineries is a prerequisite to value addition. This can help to increase the meat production, processing, value addition, and consumption. Processing of shelf-stable meat products, fermented and dried meat products, and specialty meat products having local flavors and tastes need to be developed.

Highly accurate and efficient molecular techniques by using polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP), together with several immunological methods of mitochondrial 12S rRNA gene have been developed for meat speciation. Tissue specific methods need to be developed for accurate identification of meat species.

Slaughterhouse waste disposal, development of high-value products from slaughterhouse byproducts, and biogas production are some of the areas which need attention and investments. Appropriate packaging and efficient chilling and freezing, including super-chilling technologies are required to augment clean and hygienic meat production.

VISION, MISSION and MANDATE



VISION

NRC on Meat as a premier institution of meat research to solve the problems and face challenges of meat and allied sectors development



MISSION

Development of modern organized meat sector through meat production, processing and utilization technologies to serve the cause of meat animal producers, processors and consumers



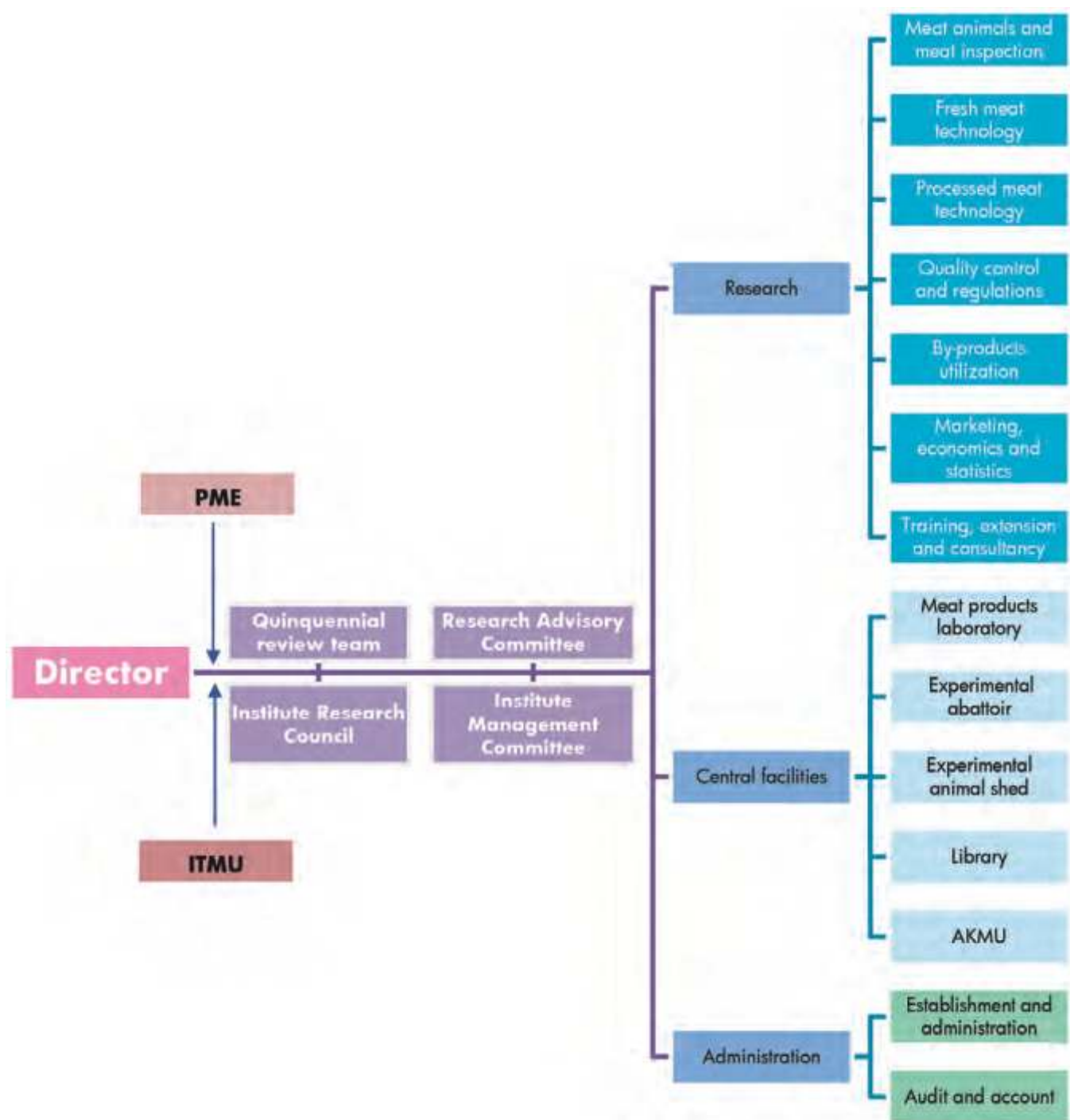
MANDATE

- Basic and applied research in meat science and technology for meat production, processing, value addition and utilization
- Capacity development for different levels of personnel in meat sector
- National repository of information in meat and allied sectors



ORGANIZATIONAL SET UP

ICAR-NATIONAL RESEARCH CENTRE ON MEAT: ORGANIZATIONAL SET UP



STAFF STRENGTH

Staff	Sanctioned	Filled
Scientific	15	14
Technical	05	04
Administrative	14	07
Skilled Supporting	02	00
Total	36	25

* As on 31st March, 2018

BUDGET

Budget details (In lakhs)

S.No.	Head	Budget	
		Sanctioned	Utilized
1	Establishment	390	390
2	Contingencies	223	204.82
3	Equipment	10	5.83
4	Furniture & Fixtures	1	0.29
5	Works	176	175.19
6	TA	15	13.44
7	HRD	2	1.9
8	Pension & ORB	42	40.24
9	NEH	00	00
	Total	859	831.71



RESEARCH HIGHLIGHTS

Institute Projects

1. Identification of important bioactive peptides from meat and slaughterhouse by-products

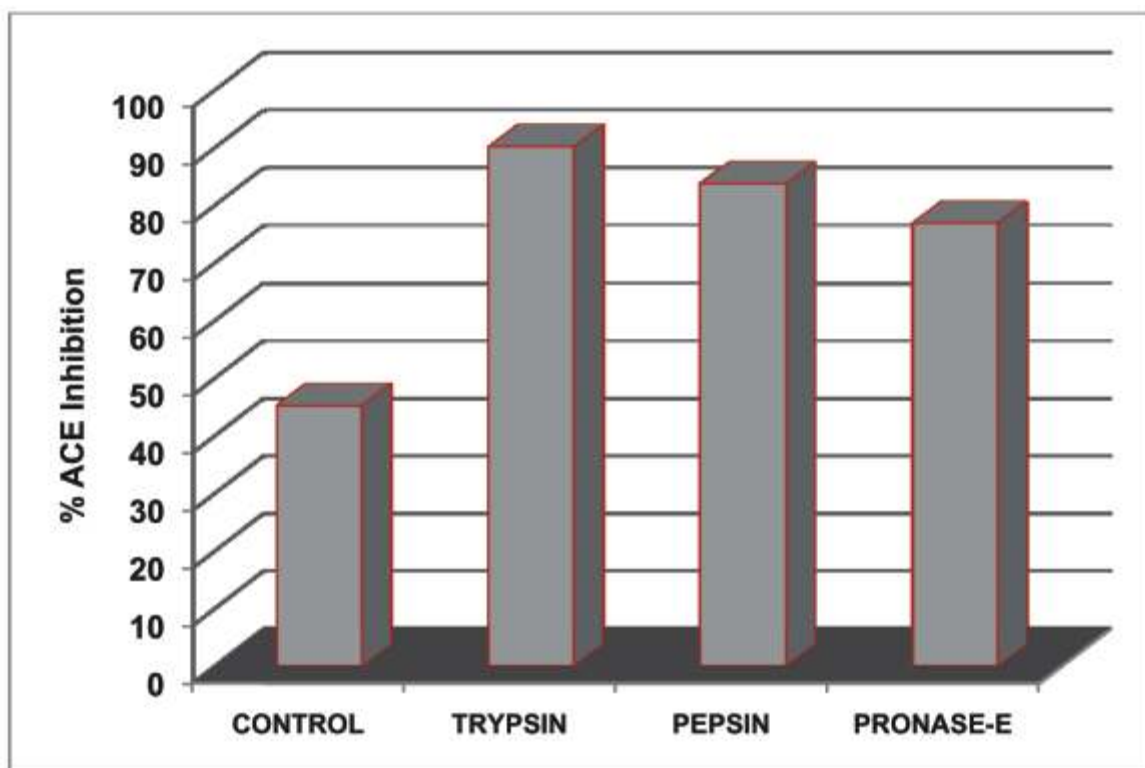
Principal Investigator : B. M. Naveena

Co-Investigators : Suresh Devatkal and Rituparna Banerjee

Low molecular weight (LMW) substances from meat are beneficial to human health through their disease preventing and health promoting activities. These bioactive compounds possess different bioactivities like antioxidant, suppressing tumor growth, wound healing, anti-fatigue, anti-stress, cholesterol lowering effects when tested in-vitro and in-vivo in laboratory animals. Most of these bioactive compounds are produced or released due to proteolytic degradation of meat proteins, catalysed by endogenous meat proteases and peptidases and/or proteolytic enzymes from the starter bacteria. The project was initiated to develop a robust, reproducible and a simple method for isolating, identifying and characterizing few meat based bioactive compounds with following objectives:

Isolation and purification of bioactive peptides/ hydrolysates from meat and important slaughterhouse by-products.

Characterization of antioxidant and ACE inhibitory activity of bioactive peptides/hydrolysates (In-vitro).



Inhibitory activity of ACE for trypsin, pepsin and pronase E hydrolyzed buffalo liver sample



Angiotensin Converting Enzyme (ACE) inhibitory peptides/hydrolysates from buffalo liver were extracted, purified and evaluated for in-vitro activity. Results revealed significantly higher ACE inhibitory activity for Trypsin (90.20 ± 3.11 %), Pepsin (83.8 ± 2.81 %) and Pronase-E (76.90 ± 3.59 %) hydrolysed buffalo liver sample relative to control (non-hydrolysed) liver samples (45.30 ± 3.59 %) indicating presence of antihypertensive peptides in buffalo liver. Mass spectrometric analysis (MALDI-TOF/TOF MS) of selected fractions revealed identification of proteins viz, Coronin-1A, Pro-FMRamide-related neuropeptide VF, Heat shock 70 kDa protein 14, Testis-expressed protein 30, 60S ribosomal protein L18a and Interferon tau-7.

2. Development of smart packaging nano-sensor for monitoring quality and safety of meat

Principal Investigator : Kandeepan.G
Co-Investigators : Suresh Devatkal and M.R.Vishnuraj

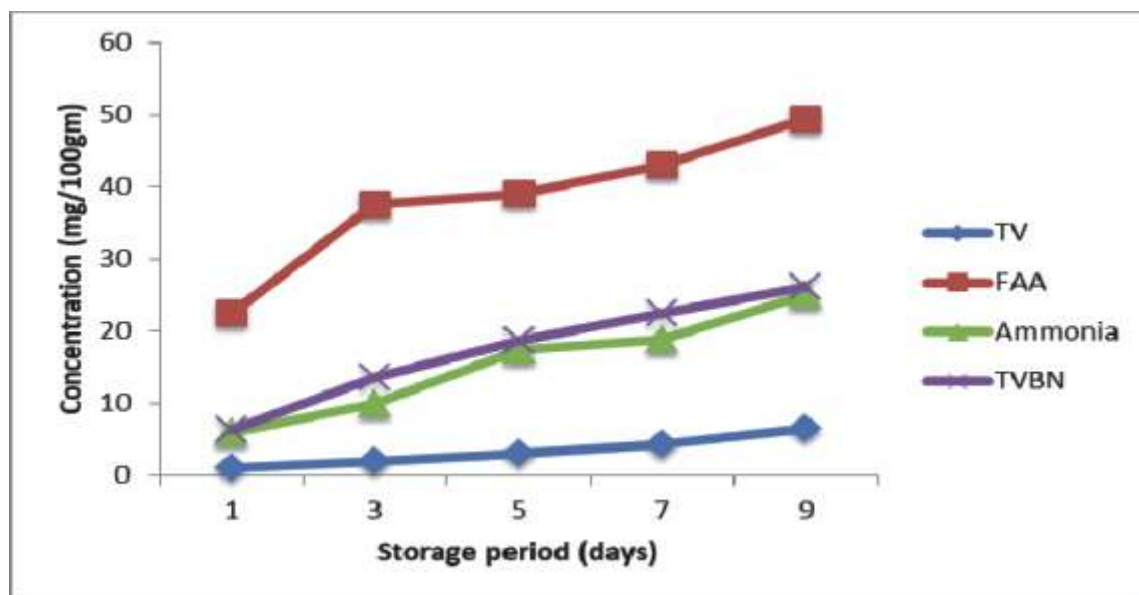
Smart packaging sensors detect the freshness of meat during storage. The volatile amines released from the stored meat due to microbial proliferation is trapped by the sensors and produce a visual color change that helps the consumer and the retailer to know about the quality of the meat contained within the package. Hence a strip-type sensor for detecting volatile amines released from chicken meat during refrigeration storage was developed. The strip was made of nitrocellulose membrane coated with anthocyanin from red cabbage, 1% silver nanoparticle and 0.1% titanium oxide. The strip was first tested for its efficacy in an indicator-metabolite model, consisting of 20 microliter ammonia as metabolite and the prepared strip (3.5×1.5 sq.cm) as the indicator. The test revealed that the strip changed color from dark pink to light brown on contact with volatile ammonia. Then the strip was used as on-package sticker-type sensor in chicken meat packaged in polystyrene foam trays with polypropylene over wrap. The samples were stored in the refrigerator and the response of strip-type sensor with the volatile amines released from chicken meat was studied. The results indicated that the color of the sensor changed from dark pink to whitish light pink during the storage period. The rate of discoloration increased as the concentration of volatile amines released increased during the progressive storage period. Simultaneous determination of quality parameters like total volatile basic nitrogen, free amino acid, tyrosine value, ammonia and pH in chiller stored chicken meat showed a significantly elevated level causing onset of deterioration of meat quality. The standard plate, psychrophilic and pseudomonas count of the microbial quality also indicated a significant increase from the initial load. Meanwhile, the sensory quality of the chilled chicken meat declined. The correlation analysis indicated a significantly positive correlation of microbial load and physicochemical quality. Hence the chemosensor developed in this research can be used for realtime monitoring of quality indication in chiller stored chicken meat.



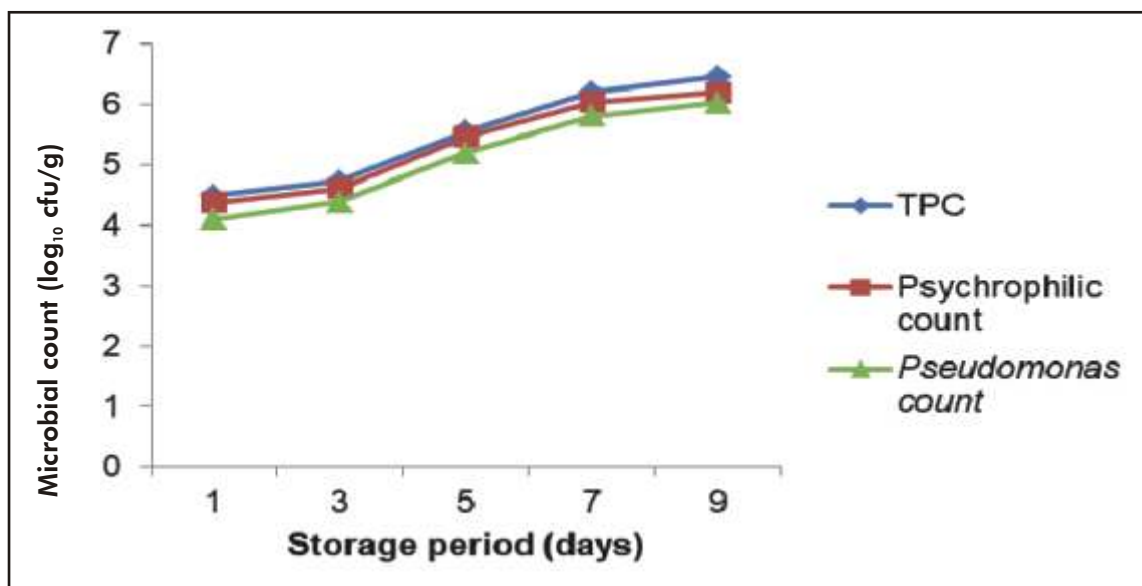
Sticker type sensor shows pale purple colour while meat quality is acceptable



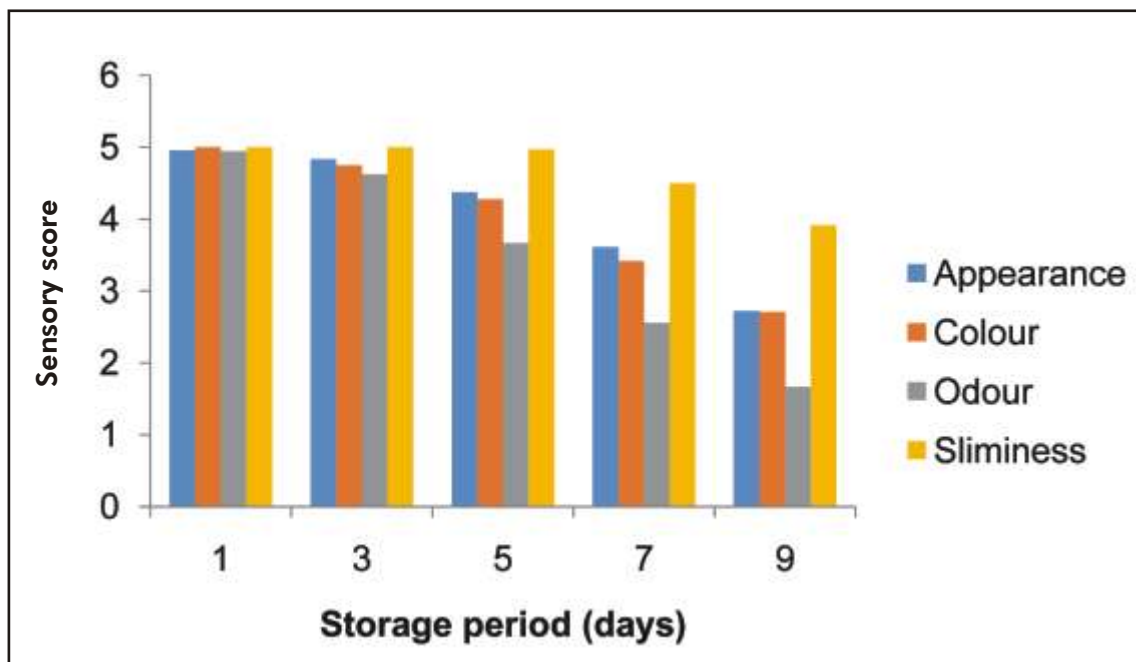
Sticker type sensor shows brownish red while meat quality deteriorates



Changes in tyrosine, ammonia, TVBN and free amino acid levels of chicken meat packaged with sensor strip at refrigerated storage



Changes in total plate count, *Pseudomonas* count and psychrophilic count of chicken meat packaged with sensor strip at refrigerated storage.

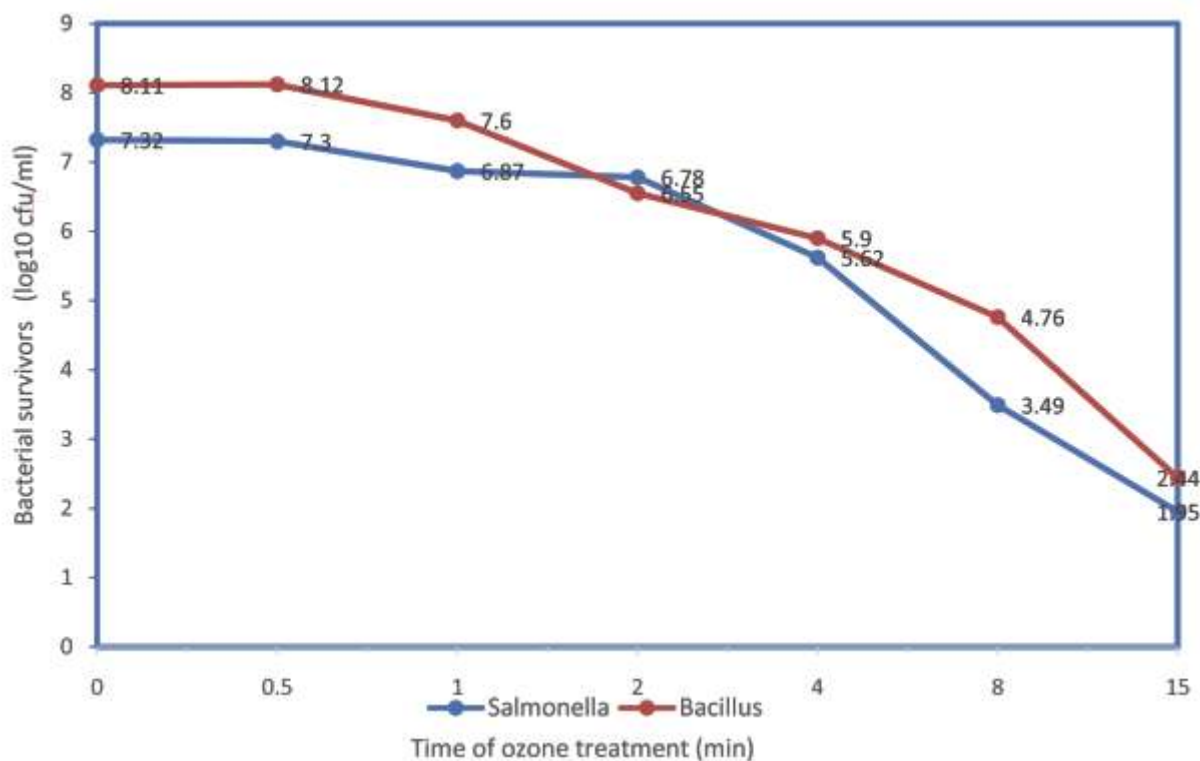


Changes in sensory score of chicken meat packaged with sensor strip at refrigerated storage (5-point scale).

3. Development of Ozone (O₃) based decontamination technology for poultry and sheep/goat carcasses

Principal Investigator : Suresh Devatkal

Bacteria were isolated from meat and meat products and equipments (bowl chopper and meat mincer, knife etc). Identification of these bacteria was done based on morphology and biochemical tests. Cultures were also sent to Veterinary College, Nagpur for confirmatory identification using MALDI-TOF, a latest bacterial identification method. Some of the isolated bacteria belongs to *E.coli*, *Salmonella*, and *Bacillus* spp. These bacterial cultures were subjected to ozone treatment to evaluate the inactivation kinetics. A domestic ozone generator with capacity to generate ozone of 200mg/hr was used in the experiment. Survival of bacteria for ozone treatment of 16 minutes was observed. A reduction of 4 to 5 log of survival was recorded after 16 min ozone treatment for different bacteria.



Effect of ozone treatment on inactivation kinetics of *Salmonella* and *Bacillus cereus*



4. Development of traceability based quality assurance system for whole meat production

Principal Investigator : Girish Patil, S.

Co-Investigators : S.B. Barbuddhe, S. Vaithiyanathan and C. Ramakrishna

The draft guidelines for implementation of meat traceability system in India have been developed and discussions with developmental agencies regarding way forward were held. Experiments were undertaken to develop techniques for molecular traceability. Developed rapid techniques for species identification of beef, buffalo meat and pork. Technique developed was based on Loop Mediated Isothermal Amplification (LAMP) technique combined with rapid DNA extraction method. AL - LAMP technique requires only water bath or dry bath for operation. It further simplifies speciation, takes only 3 hours and drastically reduces the cost of analysis and hence will be handy to food analysts for undertaking speciation analysis of meat and meat products. Based on the results prototype of kit for detection of beef, buffalo meat and pork was developed. Brief details of the technique developed for identification of pork is given below

Meat species identification by Loop mediated isothermal amplification technique

Species identification is one of the important aspects of molecular meat traceability. Several DNA based techniques have been developed for detection of meat of which Polymerase Chain Reaction (PCR) based techniques are commonly used by the food analysts. Some of the PCR based techniques applied for detection of meat are species specific PCR, sequence analysis of mitochondrial genes and PCR – Restriction fragment length polymorphism. These traditional PCR based techniques require sophisticated equipments like thermocycler, electrophoresis unit, gel documentation etc. They are also time consuming, costly and require expertise to interpret the results. Loop Mediated Isothermal Amplification (LAMP) overcomes the drawbacks associated with traditional PCR techniques. LAMP obviates the requirement of high cost equipments, process is rapid and result is easy to interpret.

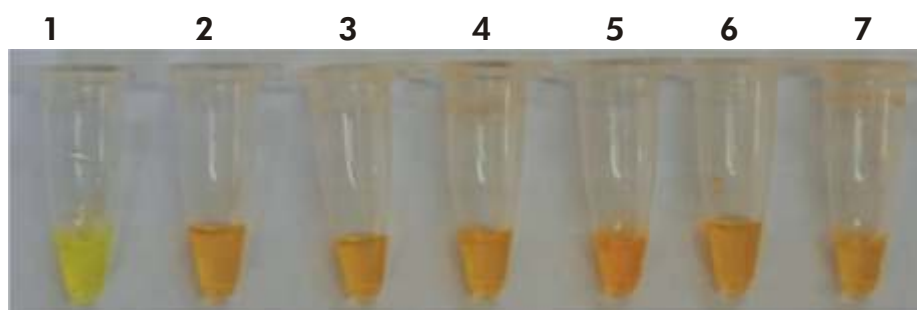
In this work, a method for detection of pork has been developed two sets of primers for Loop mediated isothermal amplification were designed for each species (cattle, buffalo and pig) by targeting mitochondrial D loop gene by using Primer Explorer V5 software. Further, a quick method for DNA extraction involving Alkaline Lysis (AL) method has been adapted which makes the process of DNA extraction and amplification simple.

Samples of meat from cattle, buffalo, sheep, goat, pork and chicken were obtained from local market of Hyderabad. DNA was extracted from meat by Alkaline Lysis method. DNA mixture containing about 50 ng DNA/ μ l was used for LAMP PCR. DNA was also extracted from meat by using DNeasy tissue DNA extraction kit for comparison.

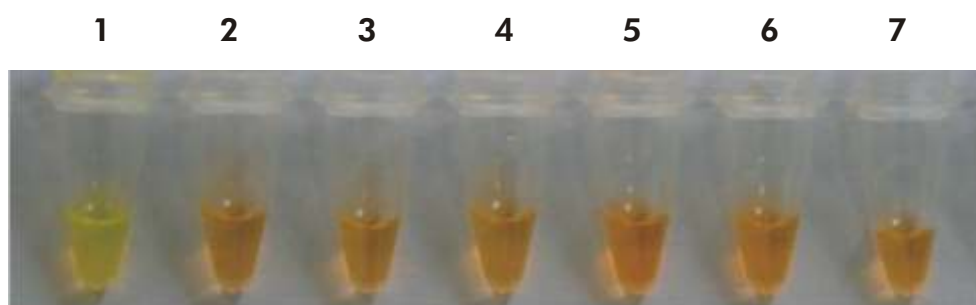
Reaction mix containing: 10 X Thermopol buffer (3 μ l), 5 M Betaine (3 μ l), 50 mM MgSo₄ (3 μ l), 10 mM dNTP mix (4 μ l), 10 pmol F3 primer (1 μ l), 10 pmol B3 primer (1 μ l), 40 pmol FIP primer (4 μ l), 40 pmol BIP primer (4 μ l) and template DNA (5 μ l) was heated at 95° C for 5 min for denaturation. After denaturation step, 8 units (1 μ l) of BstI enzyme was added to reaction mix and incubated at 65°C for 1 hour. It was followed by heating at 80°C for 2 min for inactivation of BstI enzyme. Negative control without addition of DNA was used for every experiment. After LAMP reaction, amplification was visualized by addition of 1 μ l of 1:10 SYBR green I dye (10000 X).

Positive reaction was indicated by green colour whereas negative reaction yielded orange colour.

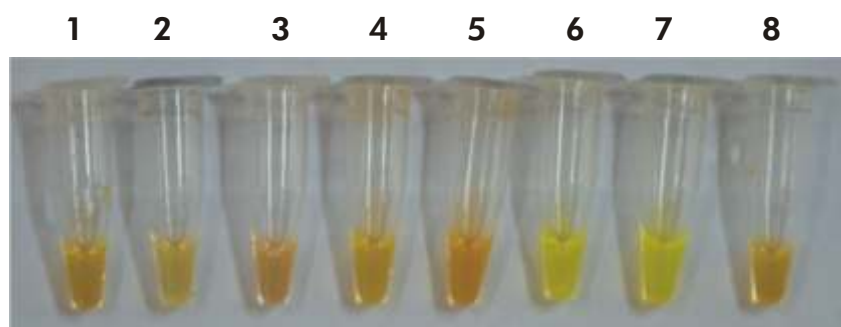
Primers specific for cattle, buffalo and pork gave positive amplification for their respective species while no amplification could be seen in other closely related meat animal species. AL – LAMP technique was applicable for species authentication even in meat samples treated at 121° C for 30 min. Technique could detect adulteration of 0.2 % of the meat. Technique was also validated in meat products commercially available in the market. Intensity of the LAMP result undertaken by using AL method was comparable with that of DNA extracted by kit method. AL – LAMP is economical as only essential equipment required for both DNA extraction and LAMP in this method is dry bath. Technique takes only 3 hours to complete.



Visualization of beef specific LAMP amplification by addition of SYBR Green I dye
1: Cattle; 2: Buffalo; 3: Sheep; 4: Goat; 5: Chicken; 6: Pig; 7: Negative control



Visualization of buffalo meat specific LAMP amplification by addition of SYBR Green I dye
1: Buffalo; 2: Cattle; 3: Sheep; 4: Goat; 5: Chicken; 6: Pig; 7: Negative control



Visualization of pork specific LAMP amplification by addition of SYBR Green I dye
1: Cattle; 2: Buffalo; 3: Sheep; 4: Goat; 5: Chicken; 6: Pig (DNA extracted using commercial kit);
7: Pig (DNA extracted by Alkaline lysis method); 8: Negative control



5. Effect of superchilling and cryoprotectants on quality and storage stability of meat

Principal Investigator : **Rituparna Banerjee**

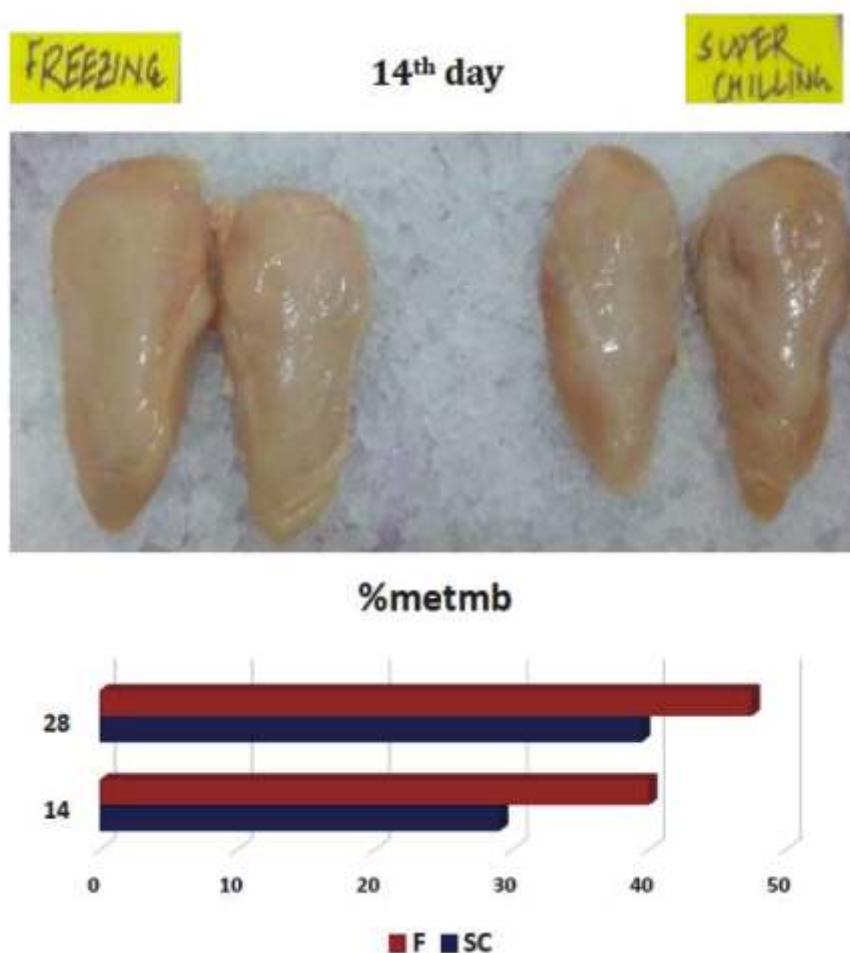
Co-Investigator : **B. M. Naveena**

Superchilling is a process, where food products are stored between their initial freezing point and 1-2° C below this temperature. The shelf life of superchilled foods can be extended by 1.5-4 times relative to chilled food and can be an attractive alternative to freezing and conventional chilling. However, some negative quality effects on superchilled foods have also been found. Researchers have reported that denaturation of myofibrillar proteins or a higher liquid loss in superchilled samples relative to ice chilled ones. To inhibit these negative changes, cryoprotectants are normally added to the products during processing to ensure maximum protein quality during icing, superchilling, or frozen storage. The project was proposed to optimize the superchilling condition and to evaluate the effect of cryoprotectants in minimizing ice-crystal formation and ultimately maintaining the quality and storage stability. A superchilling cabinet has been developed with respect to temperature and humidity to optimize the superchilling condition of dressed carcass or meat in order to improve their quality and storage stability. The cabinet is provided with a digital display which shows the temperature and humidity of the cabinet.

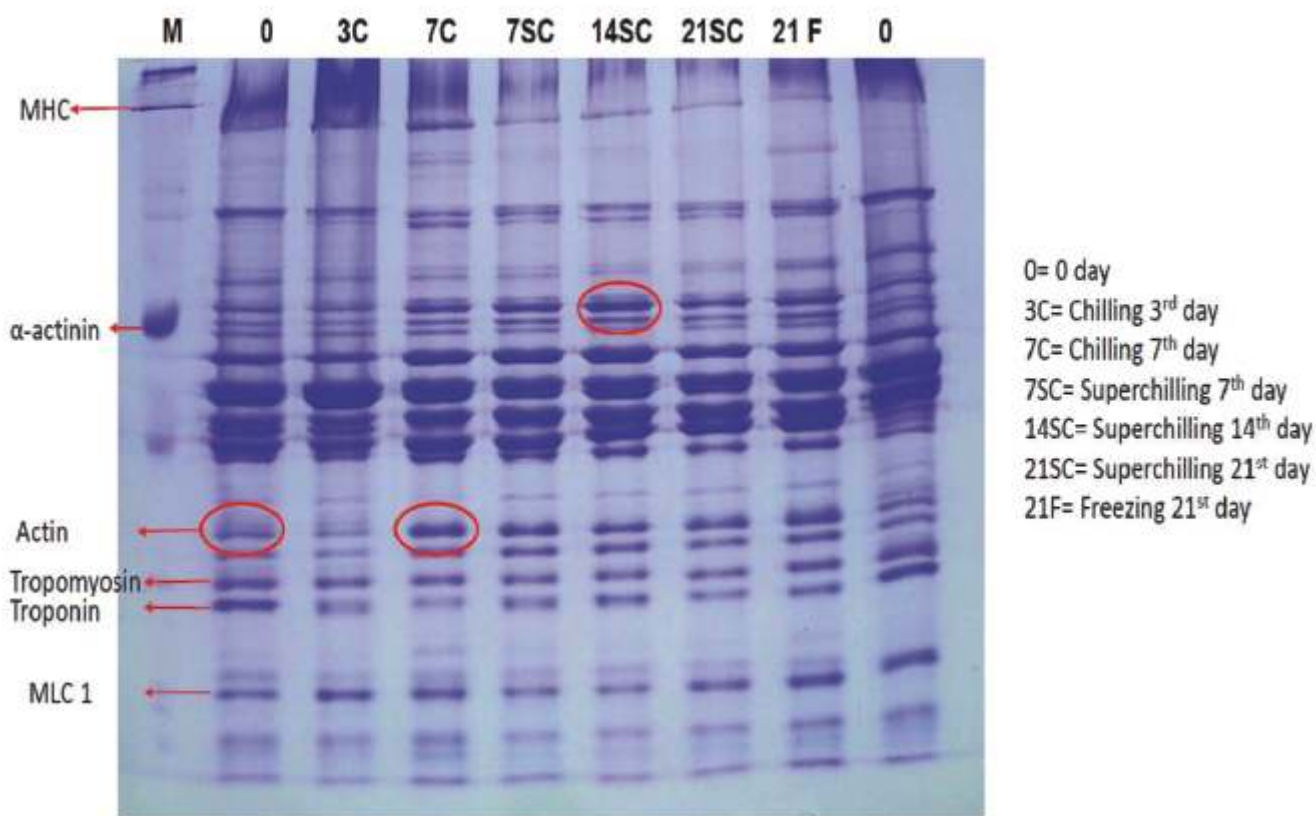


Superchilling cabinet with display unit

After slaughter, dressed birds were stored in chilling room for 4 hrs and then individually wrapped in cling film (12 μ m thickness). Wrapped carcasses were divided into 3 groups – chilling ($4 \pm 1^\circ\text{C}$), freezing (-18°C) and superchilling (-2 to -3°C). Carcasses to be stored at superchilling temperature are kept in blast freezer (-20°C) for 30-35 min and after reaching the core temperature to 1°C , transferred to superchilling cabinet for further storage studies. Samples were analysed for pH, WHC, cooking yield, TBA value, instrumental color (L^* , a^* and b^* value), % metmyoglobin, shear force value, total plate count (TPC) and coliform count on 0, 4 and 7th day for chilled, 0, 7, 14, 21, 28, 35th day for superchilled and 0, 14, 30, 60, 90, 120th for frozen carcass. pH, TPC and coliform count were decreased initially in superchilled storage and then again increased from 28th day of storage. WHC, cooking yield, a^* & b^* value, shear force were significantly ($P < 0.05$) decreased throughout the storage period, whereas L^* value, TBA value and % metmyoglobin were significantly ($P < 0.05$) increased.



Colour score and %metmyoglobin of frozen and superchilled sample on 14th day of storage



SDS PAGE pattern of salt soluble proteins extracted from chilled, superchilled and frozen meat

Quality attributes of superchilled meat was compared to chilled and frozen meat during storage. On 7th day of storage, superchilled samples showed significantly ($P < 0.05$) higher WHC, a^* & b^* values and significantly ($P < 0.05$) lower TPC and coliforms than chilled samples. On 14th and 28th day, significantly ($P < 0.05$) higher WHC, % metmyoglobin, and lower shear force were observed in superchilled samples in comparison to the frozen samples.

Sucrose, sorbitol and polyphosphates were chosen as cryoprotectants in this study and standardization of level of cryoprotectants is in progress to evaluate its effects in reducing ice-crystal formation during superchilled storage.

Superchilling (-2 to -3°C) was able to extend the shelf-life of dressed chicken upto 35 days in comparison to the 7 days' storage life of chilled samples.

6. Development of miRNA based methods for authentication of meat and meat products with respect to organ meats

Principal Investigator : Vishnuraj M. R.
Co-Investigators : S. Vaithyanathan, Suresh Devatkal, Kandeepan G.

The research objectives were formulated based on the hypothesis that certain microRNAs (miRNA) within the animal system are showing tissue specific expressions and such variations in expressions between tissues can be targeted to develop tissue specific diagnostic tests. The various tissues targeted in this study are cattle and buffalo liver, heart, blood, adipose tissue and gizzard of chicken. Micro RNA extraction from three different tissues of chicken, like liver, heart and gizzard was carried out using two different protocols. The two protocols were compared on its merit by running the product on agarose gel for size confirmation, further the extracted miRNAs were evaluated for their quality, purity and concentration using nanodrop and capillary electrophoresis in Qiaxcel advanced system. cDNA synthesis was carried out and RT-PCR for individual miRNA is under progress. At present, five chicken tissues (liver, heart, gizzard, skeletal muscle and blood) and five cattle tissues (liver, blood, intestine, adipose tissue and skeletal muscle) were processed for Next Generation Sequencing.

7. Assessment of the occupational health hazards and food safety risks associated with abattoir personnel

Principal Investigator : S. B. Barbuddhe
Co-Investigators : L. R. Chatlod and Sunil Pal Singh C.

Inadequate facilities and hygiene at slaughterhouses can result in contamination of meat and occupational hazards to workers. Information is required to assess the potential risks to workers and consumers from these facilities and can be used to assess the impact of improvements. Therefore, a project has been initiated to assess the seroprevalence of important occupational health hazards namely, brucellosis, leptospirosis and Q fever and food safety risks among butchers and slaughterhouse workers.

During the year, the questionnaires for collection of the data from abattoir associated personnel has been designed. Ethical clearance for collection of human samples has been obtained from Institutional Ethical Committee of Kamineni Academy of Medical Sciences and Research Centre, Hyderabad. The diagnostic kits required for detection of antibodies have been procured.

A total 91 serum samples were collected from occupationally exposed individuals namely, abattoir associated personnel and veterinarians. Data on personal hygiene and other epidemiological data have also been collected. The serum samples were tested for brucellosis and Q fever using serological tests. A total of 5 (5.49%) samples were positive for antibodies against brucellosis by Rose Bengal Plate Test and ELISA. None of the samples were positive for Q fever. Further collection of samples and their testing for various occupational hazards are under progress.



8. Species identification of Sarcocysts in buffalo meat

Principal Investigator : C. Ramakrishna
Co-Investigators : S. Vaithiyanathan and S. Kalpana

Sarcocystosis is an important problem associated with export of buffalo meat. The parasite has an obligatory two host life cycle having pre-predator relationships. Herbivores and omnivores act as the intermediate hosts, acquire infection by ingesting the sporocysts which are shed in the feces of carnivores (dogs and cats) known to act as definitive hosts. The distribution of Sarcocystis in intermediate hosts is recorded in various organs i.e, heart, oesophagus, diaphragm, tongue, ocular, thigh and tail muscles. On the other hand, definitive hosts become infected with Sarcocystis by ingesting the sarcocysts in the muscles of intermediate hosts. Stray dogs play a main role in transmission of infection, as they can be easily seen eating meat offal nearby slaughter houses. In India, the incidence of Sarcocystosis is found to be 60 to 80% in different States. A variety of species of Sarcocystis have been found in cattle, buffaloes, sheep, goats, horses and pigs. Major Sarcocysts of buffaloes are 1) *S. fusiformis* (definite host – cat), 2) *S. levinei* (definite host – dog) and 3) *S. hominis* (definite host – Man).

In the recently completed project entitled “Prevalence of zoonotic Sarcocystosis in export buffalo meat” three species of Sarcocysts i.e, *S. fusiformis*, *S. taeniata* and *S. buffalonis* were identified on examination of macro cysts (visible on naked eye) based on PCR, RFLP and DNA sequencing. The zoonotic *S. hominis* could not be identified. In the proposed research project, micro cysts (invisible on naked eye examination) present in buffalo meat would be examined by PCR and DNA sequencing for identifying the species of Sarcocysts and also to further explore whether zoonotic *S. hominis* is present in buffalo meat.

Meat samples from 138 slaughtered buffaloes were collected. All the 138 meat samples were examined grossly for presence of visible Sarcocysts. No Sarcocyst was observed in any of the 138 meat samples. DNA was isolated from all 138 meat samples and preserved at -20° C.



9. Organic meat production system for sustainable sheep husbandry and promotion of consumer health

Principal Investigator : P. Baswa Reddy
Co-Investigators : D.B.V. Ramana, Pankaj, C. Ramakrishna and M. Muthukumar

The research project is being carried out in collaboration with ICAR-CRIDA, Hyderabad at Hayatnagar Research Farm of CRIDA. Organic fodder is being produced in an area of 0.8 hectares. Organic fodders of CO-4, hedge lucerne, stylo, subabul are produced under organic production guidelines as per NPOP requirements. Organic certification of fodder has been carried out through APEDA accredited certifying agency 'Aditi Organic Certification Pvt Ltd', Bengaluru. After due inspection and auditing, organic scope certificate for the year 2018-19 has been awarded for the fodder as per the NPOP standards of India.

Breeding stock of sheep are being reared under cut and carry system with organically produced fodder. For organic certification of animals, 'OneCert Asia' organic certification agency which was recently accredited by APEDA to carry out auditing and certification for organic livestock was selected. Since there is no precedence of organic certification of sheep for meat production in India as per NPOP guidelines collaborative efforts are made to finalize the certification protocols along with 'Onecert Asia' an organic certification agency accredited by APEDA. The inspection and auditing of organic sheep farming has been completed by 'Onecert Asia' and the scope certificate has been issued for the organic sheep for the first time in India as per NPOP guidelines.



Honourable DG, ICAR being apprised about organic certification of sheep



Organic Sheep certificate



Organic fodder certificate

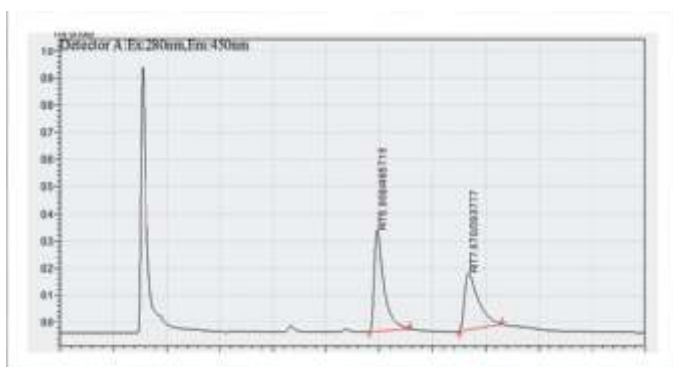
10. Determination of fluoroquinolone residues in buffalo meat samples

Principal Investigator : S. Kalpana
Co-Investigator : M. Muthukumar

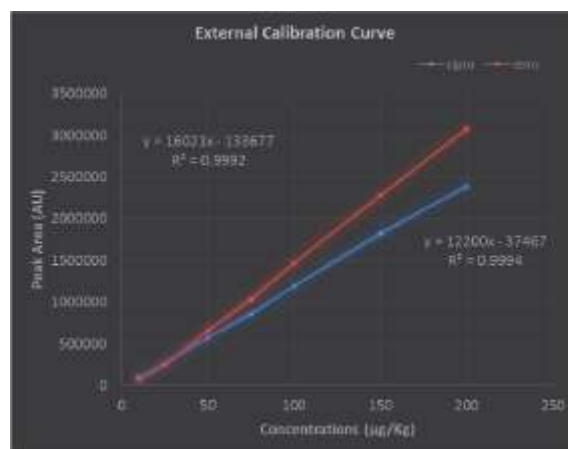
Pharmaco-epidemiological survey of antimicrobial usage in buffalo was conducted in Nalgonda district from practising veterinarians. Following which a highly sensitive RP-HPLC method was standardized using a fluorescent detector (at an excitation wavelength of 280 nm and emission wavelength of 450nm) and C8 column, keeping in view the Codex MRL, for a widely used fluoroquinolone enrofloxacin and its active metabolite ciprofloxacin in buffalo meat samples. The raw data were processed using regression analysis and the limits of quantification for enrofloxacin and ciprofloxacin were found to be 36.27 and 30.38 $\mu\text{g/Kg}$ respectively. The RP-HPLC analysis of about 270 buffalo meat field samples was done, of which six samples were found to be positive and their levels were in compliance with Codex MRL.



Pharmaco-epidemiological survey conducted on antimicrobial usage with practicing veterinarians



Optimized representative Chromatogram of enrofloxacin and ciprofloxacin



External Calibration Curve



11. Study on prevalence, characterization and antibiotic resistance of *Salmonella*, and *E.coli* in meat and ready to eat meat products

Principal Investigator : L.R. Chatlod

Co-Investigators : B.M. Naveena and M. Muthukumar

A total of 293 raw meat samples (chicken, mutton, pork & buffalo meat) were collected from different retail shops and processed for isolation and identification of *E.coli* and *Salmonella*. Samples were collected in sterile polythene sachets by adopting the standard aseptic measures and transported to lab under chilled condition and immediately processed for isolation

Samples were inoculated in enrichment broth (MacConkey broth for *E.coli* & Tetrathionate broth for *Salmonella*) Incubation was done at 37°C for 24h. Enriched inoculum was streaked on selective agar (EMB for *E.coli* & HEA for *Salmonella*). Incubation was done at 37°C for 24h. Characteristic colonies were picked up on Nutrient agar. Confirmation of the suspected isolates was done by biochemical tests.

All isolates were examined for their antimicrobial susceptibility/resistance pattern by disc diffusion technique against a panel of 15 antibiotics.

Isolates were grown in broth at 37°C for 12h. Individual broth culture was then smeared on the surface of Mueller-Hinton agar plates with the help of sterile cotton swab. Plates were allowed to dry for few minutes. Antibiotic discs were placed on the agar surface within 15 minutes of inoculation of the plates. The plates were incubated overnight at 37°C.

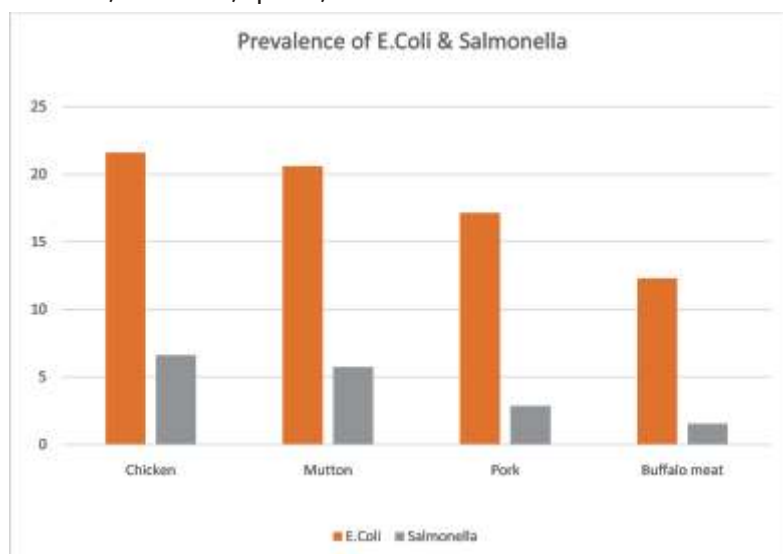
Sensitivity or resistance of an isolate for a particular antibiotic was determined by measuring the diameter of the zone of growth inhibition. The result was interpreted as sensitive, intermediate or resistant by comparing with manufacturer's instructions.

Screening of 293 samples from chicken, mutton, pork, and buffalo meat indicated an incidence of 18.77% and 4.77 % of *E.coli* and *Salmonella* spp., respectively.

E.coli were recovered from 21.6% of chicken, 20.6% of mutton, 17.14% of pork and 12.3% of buffalo meat samples.

Salmonellae were recovered from 6.6% of chicken, 5.74% of mutton, 2.85% of pork and 1.53% of buffalo meat samples.

Predominant Serotypes of *E.coli* were O35,O126,O119,O2



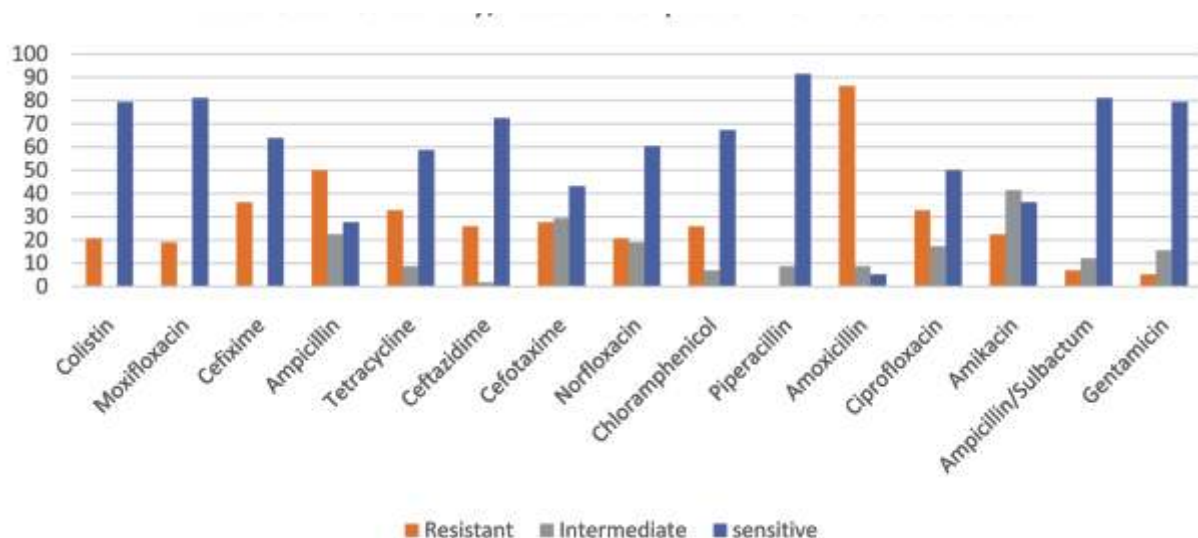
Sl.No	Meat type	No of samples screened	No of samples + for	
			<i>E.coli</i> (%)	<i>Salmonella</i> (%)
1	Chicken	106	23(21.6)	7(6.6)
2	Mutton	87	18(20.6)	5(5.74)
3	Pork	35	6(17.14)	1(2.85)
4	Buffalo meat	65	8(12.3)	1(1.53)
	Total	293	55(18.77)	14 (4.77)

Amoxicillin (86.2%), ampicillin (50.0%), cefixime (36.2%) and tetracycline (32.75%) showed higher resistance against *E.coli* isolates.

Lower resistance was observed against gentamicin (5.17%), ampicillin/sulbactam (6.89%) and moxifloxacin (18.96%).

Piperacillin (91.37%) was found to be most effective antibiotic. The other antibiotics that were found to be effective against *E.coli* were moxifloxacin (81.03%), ampicillin/sulbactam (81.03%), colistin (79.31%) and gentamicin (79.31%).

Amoxicillin (5.17%) and ampicillin (27.58%) were found to be least effective.

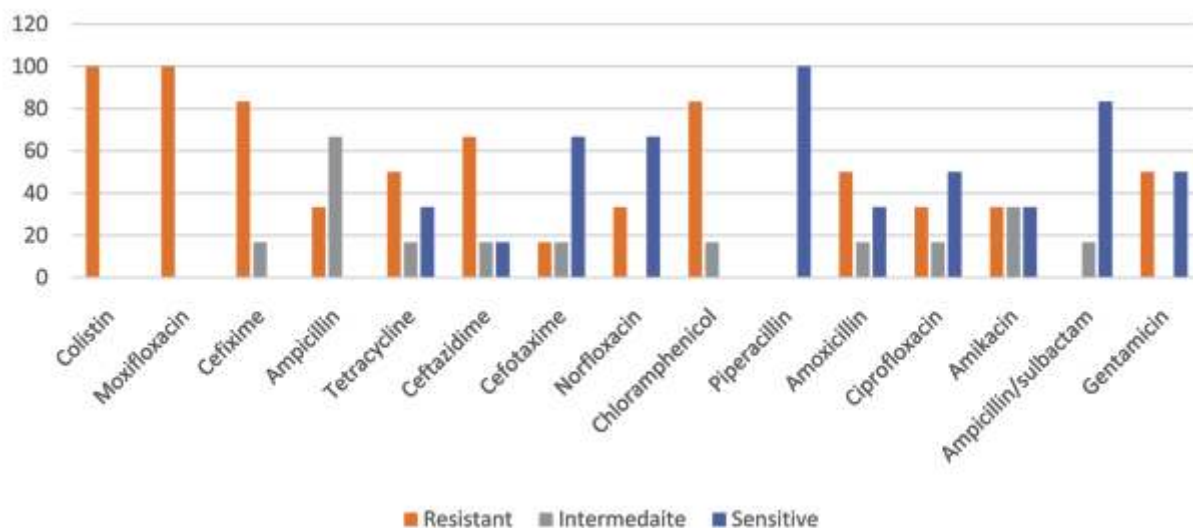


Antibiotic sensitivity/resistance pattern of *E. coli* isolates



Colistin (100%), moxifloxacin (100%), cefixime (83.33%) and chloramphenicol (83.33%) showed higher resistance against *Salmonella* isolates.

Piperacillin (100%) and ampicillin/sulbactam (83.33%) were found to be most effective antibiotics. The other antibiotics that were found to be effective against *Salmonella* isolates were cefotaxime (66.66%) and norfloxacin (66.66%). Ceftazidime (16.66%) was found to be least effective.



Antibiotic sensitivity/resistance pattern of *Salmonella* isolates

12. Impact of meat research on livestock sector development–Role of public investment

Principal Investigator : K. Varalakshmi

India is the world's 5th largest meat producer with 7 million tons which account for 2.7% of world meat production of 258.23 million tonnes in 2015-16. In the backdrop of increasing role played by meat sector in the economy, Meat Research is also gaining importance. While the National Research Centre on Meat (NRCM) has been long considered a premier institute in meat research, no prior study has attempted to evaluate the impact of NRCM research on its stakeholders. Estimating the impact of NRCM's research will help in identifying its contribution to meat sector and will inform the policy makers to effectively frame strategies for the research portfolio of meat sector. With this backdrop the study has been taken up to assess the impact of NRCM research on its stakeholders

Budget

Budget of NRCM has increased from 1.83 crores in 2007-08 to 8.02 crores in 2016-17 registering a growth rate of 15.01% CAGR for the 10 year period.

Overall NRCM has spent 46.6 crores for the 10 year period with major share accounted by recent period i.e PII (29.58 crores) where as it was only 17.01 crores in PI.

Projects

NRCM has taken up 56 projects for the 10 year period from 2007-08 to 2016-17. Out of which 36 were completed and 3 were discontinued and 17 are still continuing. Out of 53, 20 were taken up in PI (2007-08 TO 2011-12) and 33 were in PII (2012-16). Average duration of projects is 3.13 years.

Total no of effective projects per scientist per year is 1.13 growing at the rate of 3.58% with slight variation between periods (1.03 in PI and 1.23 in PII with 7.15% & 1.24% CAGR).

Research Productivity

NRCM has published total of 152 research papers for the 10 year period with average of 15.2 per year growing with a CAGR of 12.66%. Out of 152 peer reviewed articles are 82.

Regarding publication productivity, NRCM staff has published 1.04 paper per scientist for overall period but productivity differs among the periods with high productivity reported in PII (1.05) where as it was only 1.03 in PI. Trend of publication productivity showed that productivity was increasing at the rate of 7.01% CAGR for the study period. The bibliometric analysis of research showed high degree of collaboration (92%).

Technology

Impact of NRCM technology on stakeholders showed that more stakeholders were benefited by Emulsion technology. Emulsion technology contributed for 66.67% & 61.58% of technology Transfer and revenue generation. Overall NRCM is said to be weak in attracting more entrepreneurs for adoption.

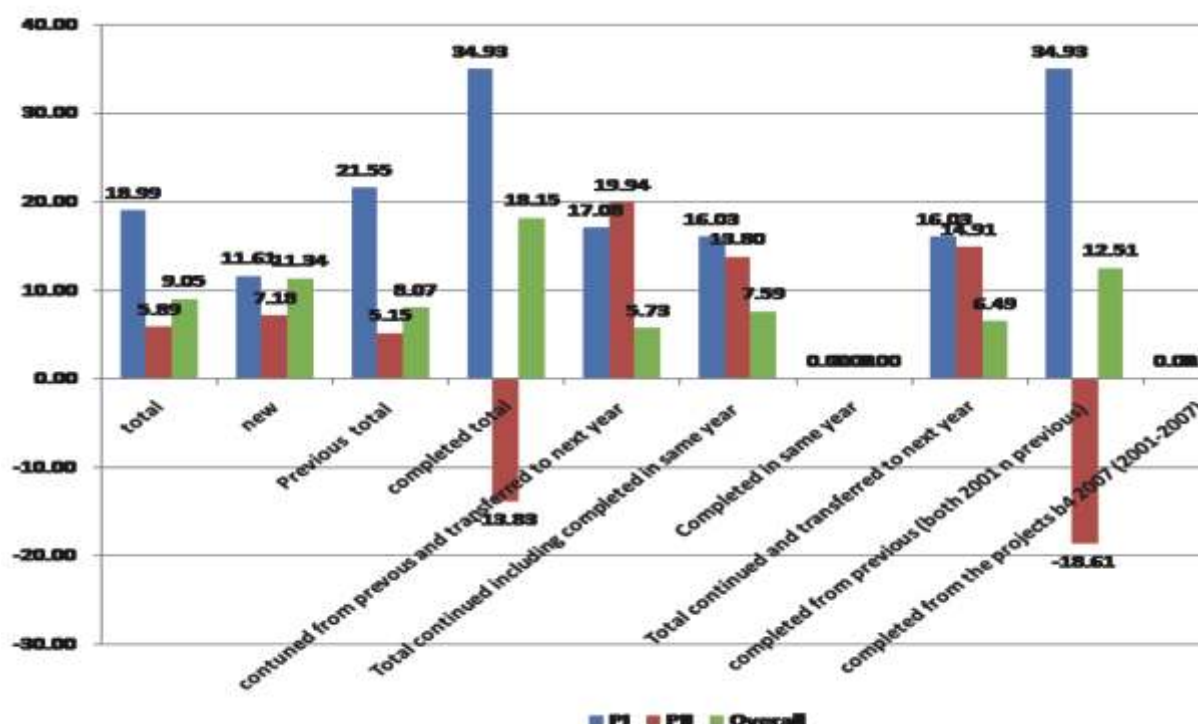


Technology spread across zones revealed that more than $\frac{3}{4}$ (87.5%) of technologies adopted by industries belong to Southern states of India especially Telangana (80.95%). Across the technology categories, emulsion technology showed medium technology spread index of 4.92 compared to other technologies with low index of 1. Overall TSI of NRCM is turned out to be medium.

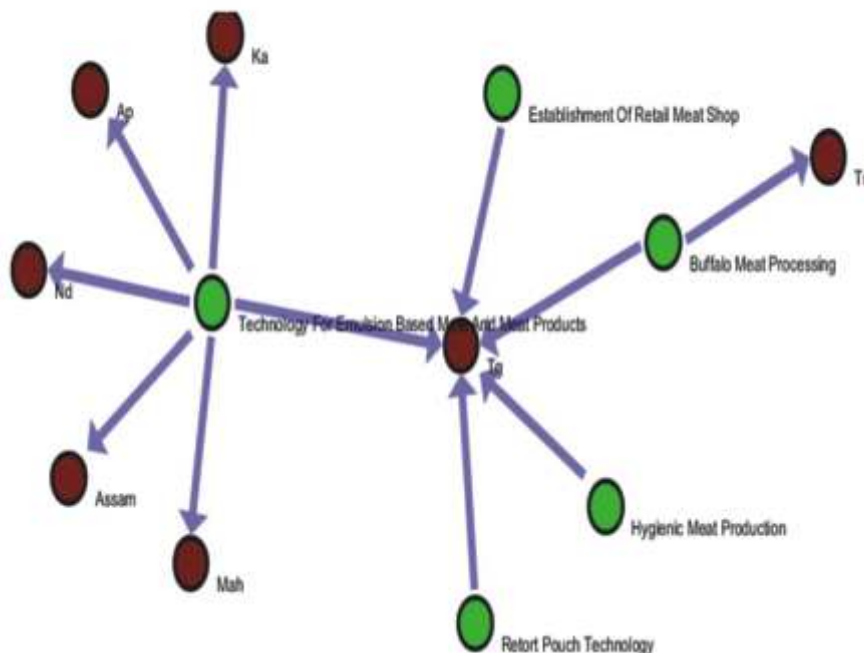
The majority of stakeholders were benefitted by training on clean meat production and chicken processing as indicated by no of participants.

Teaching

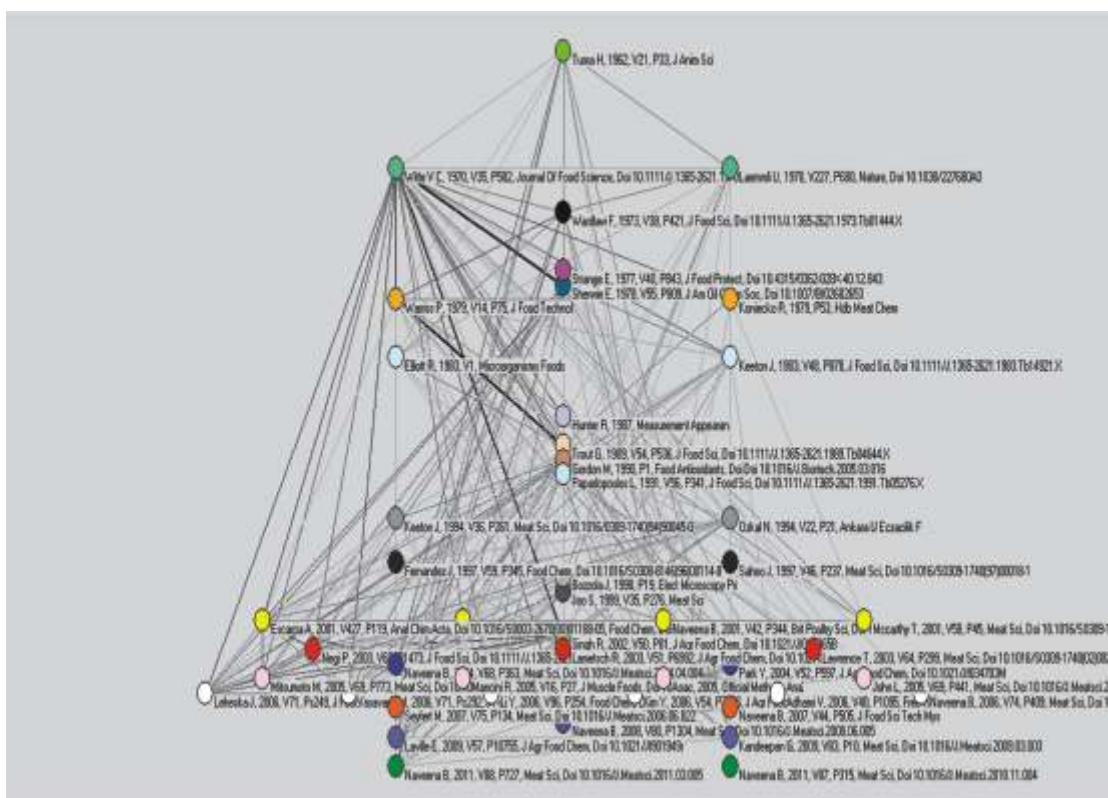
Teaching is concentrated towards state veterinary universities in south especially Telangana State Veterinary University due to close proximity.



Trend in no of projects during different periods (CAGR %)



Technology spread across states



Citation analysis of one of most productive authors of NRCM (B.M.Naveena)



Externally funded project

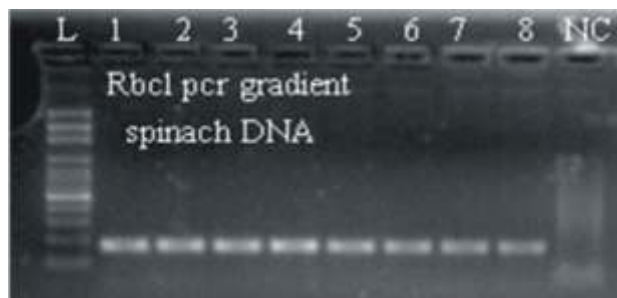
1. Detection and quantification of animal body fat (tallow)/vegetable fat in milk fat/ghee

Funding Agency	: Ministry of Food Processing Industries (MFPI), Govt. of India
Principal Investigator	: S. Vaithiyanathan
Co-Investigators	: S. Kalpana, Rituparna Banerjee

The present study is aimed at developing a technique based on PCR assay to detect and quantify animal body fat/vegetable fat in milk fat/ghee in known and unknown samples. A method was standardized to isolate DNA from animal body fat/milk fat and vegetable fat. The DNA isolated from milk fat, animal body fat and vegetable fat was not of good quality in terms of A260/A280 ratio. However, the isolated DNA quality was sufficient enough to get amplified by the mitochondrial and chloroplast primers in the PCR assay.

The rbcl assay

The rbcl assay is plant specific assay set up to detect any plant DNA in the binary mixtures. In the present work, the DNA isolated from the ghee and vegetable fat was used in the PCR assay to detect the plant DNA. The PCR assay exhibited the amplicons of expected size of 174bp. The rbcl PCR assay was specific to plant and not shown any cross reactivity with animal DNA. Further work is under progress.



rbcl for plant specific PCR assay

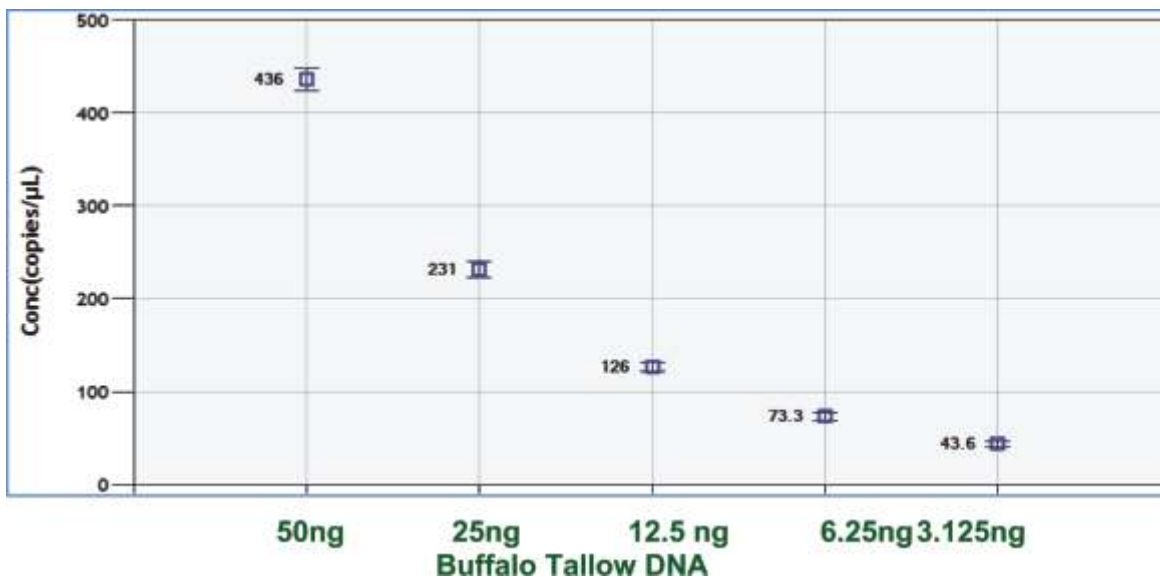


rbcl for plant specific PCR assay and no cross reactivity towards animal DNA

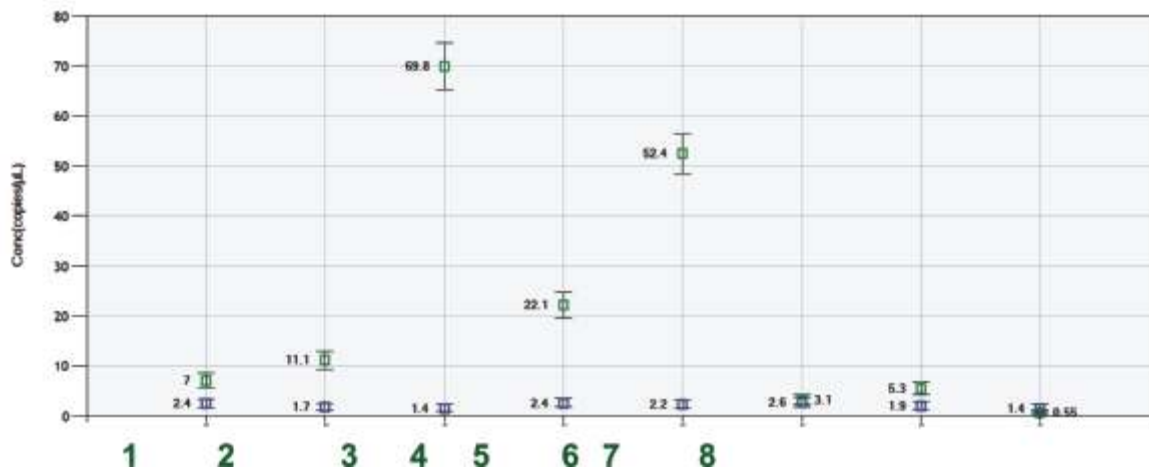
Vegetable fat (%) 8=35; 9=40; 10=50; 11=60; 12=70; 13=80; 14=90; 15=100; 16= ground nut oil

The ddPCR assay

Droplet Digital polymerase chain reaction (ddPCR) assay is a robust technique to provide high-precision, absolute quantification of nucleic acid target sequences. It measures absolute quantities by counting nucleic acid molecules encapsulated in discrete, volumetrically defined water-in-oil droplet partitions. The droplet generator partitions samples (20 μ l PCR reaction mixture) into 20,000 droplets. PCR amplification is carried out within each droplet using a thermal cycler. After PCR, droplets are streamed in single file on a droplet reader, which counts the fluorescent positive and negative droplets to calculate target DNA concentration.



The serial dilution effect on the DNA and the copy number of the buffalo cyt b sequence



The detection of DNA in the commercial cow ghee using ddPCR assay (cow-Blue and buffalo-Green (cyt b))

The serial dilution of animal fat DNA at 1:2 with starting DNA concentration of 50ng and diluting up to 3.125 ng showed a correlation coefficient of $R^2=0.99$. The detection of cow and buffalo DNA in the commercial milk fat showed that 4 out of 4 samples sold as cow ghee contained buffalo DNA. Further work is under progress.



2. Species identification to check adulteration of cheaper quality meat in meat

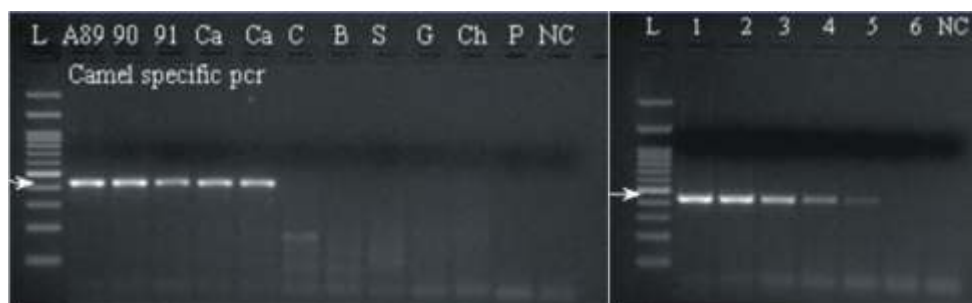
Funding Agency : Food safety and standards authority of India (FSSAI)
Principal Investigator : S. Vaithiyanathan

Detection and identification of different species of meat in meat products

We have established protocols for meat species identification for mutton, chevon, pork, buffalo meat and camel meat in meat mixtures. The detection of beef in buffalo meat mixture showed a sensitivity of 0.1%. The detection of chevon in sheep meat mixtures, sensitivities of 10% chevon and 5% mutton in the binary mixtures were observed. The detection of pork/chicken in sheep meat mixtures showed a sensitivity of 0.1%. The detection of beef/buffalo meat in sheep meat mixtures showed a sensitivity of 1%.

Detection of camel meat

The slaughter and sale of unconventional meat such as camel meat is illegal in India. In order to develop a specific test to detect the camel meat, we have developed a PCR assay using mitochondrial cyt b gene primer. The developed PCR assay is highly specific and the limit of sensitivity is up to 0.01 ng DNA template.



Electrophoretic analysis of camel specific PCR assay products and the PCR sensitivity assay

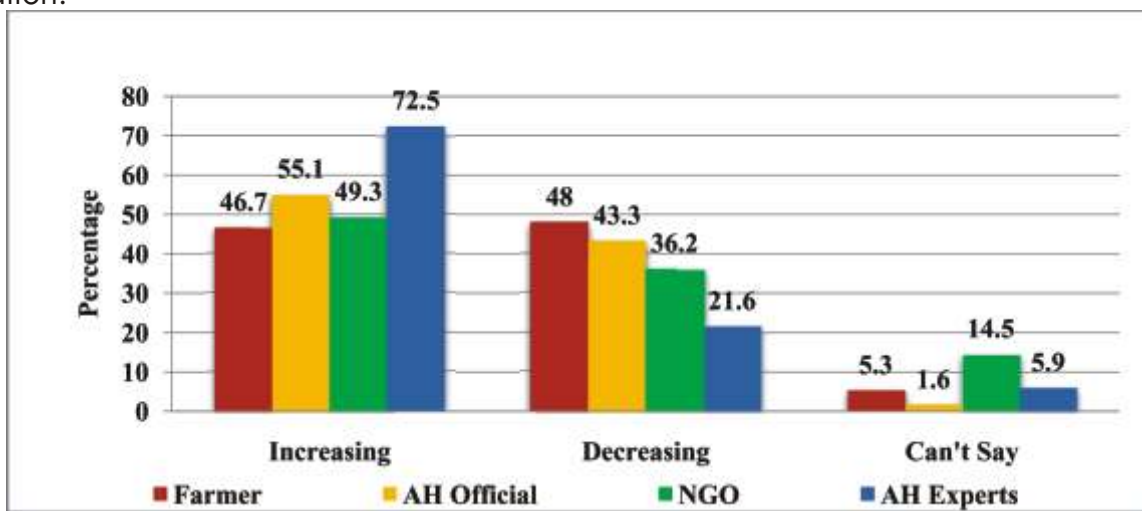
Analysis of Haleem samples

LCD array technique associated with a commercial DNA macro-array spotted with meat-specific capture probes for simultaneous detection of 32 meat species, in a chip platform, was utilized to detect any misrepresentation in Haleem samples. The samples (n=100) were collected from hotels and retail shops of Hyderabad during Ramzan months of 2016 and 2017. The DNA was extracted by spin column method, and the PCR assay (target gene, 16S rRNA) and hybridization were done as prescribed in manufacturer's kit. Out of 78 mutton Haleem samples analysed, 12(30%) samples during 2016 and 17(44.7%) samples during 2017 were found to be mislabelled. Similarly, beef Haleem showed adulteration in 9 out of 10 samples in 2016 and 7 out of 9 samples in 2017. From 3 chicken Haleem samples analysed in 2017, only one showed mislabelling. From 29 mislabelled mutton Haleem, 14 contained chicken, 4 with carabeef, 4 with beef, 1 with both beef and carabeef, 5 with chicken and carabeef and one with chicken, beef and carabeef. Similarly, out of 19 mislabelled beef Haleem samples, 8 contained both beef with carabeef and 6 contained beef without carabeef, along with misrepresented species like chicken in 9 samples, goat in 7 samples, sheep in all 16 and camel in one. The one adulterated chicken Haleem was detected with the presence of both sheep and buffalo meat.

3. Effect of buffalo slaughter and meat export policy on livestock, milk, draught power and eco-balance in India

Funding Agency	: APEDA, Govt.of India
Project leader	: V.V. Kulkarni
Principal Investigator	: M. Muthukumar
Co-Investigators	: C. Ramakrishna, Suresh K. Devatkal, P. Baswa Reddy and K. Varalakshmi

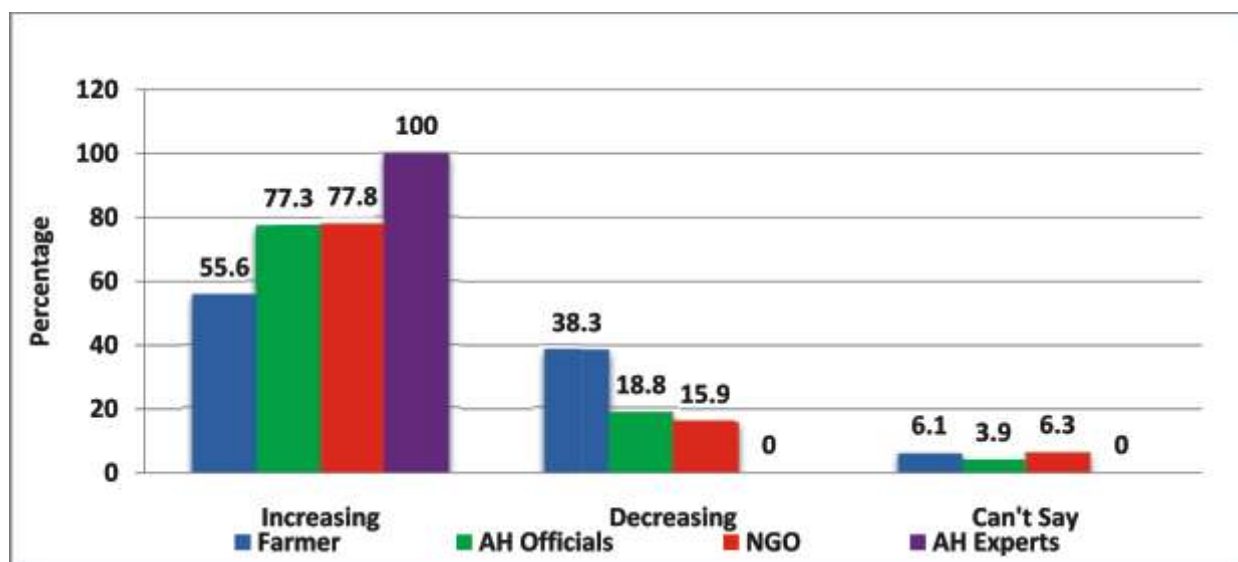
The analysis of impacts of the slaughtering of buffaloes and meat export policy on the livestock production systems, food security and eco-balance was done. Primary data on various aspects of buffalo rearing and disposal was collected from various stakeholders from Uttar Pradesh, Andhra Pradesh, Punjab, Gujarat and Maharashtra. The secondary data were sourced from planning commission reports, census reports, expert committee reports, policy documents, etc. In total, 4686 stakeholders comprising 3868 farmers, 370 animal traders, 78 livestock markets, 137 meat traders, 39 domestic slaughterhouses, 128 Animal Husbandry officials, 52 livestock experts, 11 export slaughterhouses, 69 NGOs and 163 consumers were interviewed for first-hand information. Data analysis revealed that buffalo population increased from 43.40 million in 1950 to 108.70 million in 2012. The proportion of buffaloes among total livestock species also increased from 14.82 percent in 1951 to 21.23 percent in 2012. The average growth rates of buffaloes during non-meat export period (1951-1982 -1.60%) and export period (1982-2012 -1.50%) remained almost the same. About 46.7% of farmers, 55.10 % of AH officials, 49.3% of NGOs and 72.5% of Animal Science experts opined increase in the buffalo population. The farmers from Andhra Pradesh (66.80%), Punjab (47.27%) and Uttar Pradesh (49.83%) and officials of Maharashtra (55.56%) and Andhra Pradesh (74.19%) indicated decline in buffalo population.



Opinion of various stakeholders about the trends of buffalo population over the last 20 years



The country's milk production has increased from 28.50 mm tonnes in 1977 to the current production of 155 mm tonnes. Further, the per capita milk availability also increased from 125 g per day in 1977 to 337g in 2016. Among the stakeholders, 55.6% of farmers, 77.3% of AH officials, 77.8% of NGOs and 100% of Animal Science experts had stated increase in the milk production over a period of time. Draught buffalo population decreased by 44.42 percent during 1992 to 2012. Accordingly majority of the farmers (68%) opined that the usage of male buffaloes for draught purpose has declined over a period of time. Meat export policy enables salvaging the spent and unproductive buffaloes for meat production, which in turn prevents adverse effect on ecobalance by large number of unproductive animals. However, many stakeholders are unaware of the effect of export policy on the eco-balance and environment. This study revealed that buffalo meat production and export has positive effect on buffalo population and productivity. Further, there were no adverse effects on draught animal power requirements and ecobalance. Therefore, buffalo meat production and export significantly contribute toward sustainable buffalo production.



Opinion of various stakeholders about the trends of milk production over the last 20 years

4. Production of Selenium enriched functional meat through nutrient supplementation in sheep

Funding Agency : Ministry of Food Processing Industries, Govt. of India
Principal Investigator : P. Baswa Reddy
Co-Investigators : D. B. V. Ramana, M. Muthukumar

In the first phase of animal experiments, ram lambs were fed with different sources of selenium in the diet by mixing them in the complete feed (Total Mixed Ration). After the feeding trial, animals were slaughtered to study the carcass characteristics, meat quality parameters, selenium content in different muscles and organs etc. It was found that the supplementing selenium in the form of seleno-methionine in the feed resulted in highest incorporation of selenium into meat and organs. Based on the results of first experiment seleno-methionine was selected and a second animal experiment was conducted to determine the optimal dosage of incorporation of seleno-methionine in the diet. Seleno-methionine was supplemented in the total mixed rations (TMR) to four different groups of ram lambs @ 0, 250, 500 and 1000 ppb. The feeding trial was carried for 120 days. Feed intake and growth performance was recorded during the period. After the feeding period, animals were slaughtered to study the carcass characteristics, meat quality parameters, keeping quality of meat, blood parameters, selenium levels in muscles and organs, glutathione peroxidase (Gpx) levels etc., were determined. From the results, it was found that supplementation of seleno-methionine @ 500 ppb in the diets of Nellore brown ram lambs was optimal for effective incorporation of selenium into meat and edible organs. Value added selenium enriched functional meat products like nuggets and meat balls were prepared from the selenium enriched meat.

Table 1: Selenium content (ppb on DM basis) in different muscles and organs in different groups

Tissues	Gr1 (Control)	Gr2 (250ppb)	Gr3 (500ppb)	Gr4 (1000ppb)	p
LD muscle	47.18±2.34	95.97±12.84	180.17±22.83	190.98±8.61	<0.001
Thigh muscle	122.85±8.77	220.72±25.04	504.83±49.73	537.18±48.23	<0.001
Breast muscle	83.19±4.74	140.67±3.90	272.65±30.19	302.89±14.49	<0.001
Liver	520.89±53.98	595.28±69.43	643.66±102.50	819.36±101.46	0.108
Kidneys	651.83±68.63	744.28±86.81	957.44±71.98	1017.05±129.40	0.031
Heart muscle	140.37±14.55	179.32±12.79	242.24±36.43	269.46±35.82	0.011
Testicles	518.19±71.76	547.23±42.33	606.38±43.44	632.88±39.05	0.379



Selenium enriched meat products

5. Training and capacity building in sheep and goat value chain

Funding Agency : National Livestock Mission, Govt. of India
Principal Investigator : P. Baswa Reddy
Co-Investigator : M. Muthu kumar

Different training and capacity building programmes were conducted for the stakeholders of sheep and goat value chain under the National Livestock Mission (NLM) funded project on 'Training and capacity building in sheep and goat value chain'. A total of five programmes were conducted for farmers and veterinarians during the year under report. The details are as follows.

- i) A three days training programme for the sheep and goat farmers of Telangana was organized during 12 to 14 December, 2017 on 'Prospects of scientific small ruminant rearing, slaughter and value addition in Telangana'. A total of 63 participants including chairmen and directors of district sheep breeding societies of Telangana attended the programme.
- ii) A training programme for the field veterinarians of Telangana state was conducted from 20th to 23rd December, 2017 on 'Recent developments in small ruminant rearing, meat quality control and value addition' to sensitize them about the recent developments in sheep and goat farming practices and impart them hands on exposure to clean meat production and value addition to meat. A total of 30 participants from different districts of Telangana state participated in the training programme.
- iii) Upon request from the Joint Director TSVBRI, Hyderabad, exclusive training programme for the veterinarians working in the Quality Assurance Lab, TSVBRI and ADDLs was conducted from 17th to 20th January, 2018 on 'Meat quality testing and molecular techniques for detection of meat adulteration'. This programme included a hands on training experience to acquaint the participants about the recent developments and advances in molecular techniques in meat quality control. A total of 11 veterinarians attended the programme.
- iv) Hands on training programme for the second batch of veterinarians working in TSVBRI and ADDLs was conducted from 6th to 9th February, 2018 on 'Meat quality testing and molecular techniques for detection of meat adulteration'. A total of 10 veterinarians from TSVBRI, and Animal Disease Diagnostic Labs (ADDLs) of different districts of Telangana participated in the programme.
- v) An awareness programme for the sheep and goat farmers of Mancheriyal district was conducted in Mancheriyal town on 27th January, 2018 to educate the resource poor farmers about the recent developments and opportunities in sheep and goat sector.



Hon'ble MLC Dr M Srinivas Reddy addressing the farmers



Visit to organized sheep and goat farm



Shri Suresh Chanda, Special Chief Secretary releasing the training manual.



Training classes



Training on slaughter, anti-mortem and post mortem inspection



Visit to modern sheep and goat abattoir, Chengicherla, Hyderabad



Value added meat products processing



Hands-on training on molecular techniques for detection of meat adulteration



The Director, NRCM distributing certificates to participants



Sheep and goat farmers at Mancherial



The Director, NRCM addressing the farmers at Mancherial



6. National Agricultural Innovation Fund (NAIF) Project

Funding Agency	: ICAR, Govt. of India
Principal Investigator	: M. Muthukumar
Co-Investigators	: Suresh K. Devatkal, Naveena, B. M., Girish Patil, S., Kandeepan, G., Rituparna Banerjee and Vishnuraj, M.R.

Under the component I (Institute technology management unit) the intellectual properties generated in the institute are being protected through filling patents/copy right. The technologies developed at the centre are disseminated through participations in various exhibitions/melas. Under the component II, the ABI centre is being established with the objective to generate employment opportunities and promote viable enterprises in meat / poultry processing. During the year 2017-18, 2 training programmes on clean meat production and 5 paid trainings on value added meat products processing were organized and 61 entrepreneurs were given hands on training on value added meat products processing. Seven MoU's were signed with entrepreneurs for establishment of slaughterhouse and value added meat products processing unit.

I. Management of IP portfolio

IPRs	Application/ Registration No.	Name of Innovation/ Technology/ Product/ Variety	Date of Filing/ Registration	Application Granted/ Registered**
Patent	TEMP/E-1/ 20342/2017- CHE	A process for making uniform, smooth and succulent seekh kebabs without hardening of outer layer	07-06-2017	Filed
		A meat based high protein and low fat meal maker	Request for examination was filled on 13/06/2017	Filed
Design	290498	Burger patty mould	31-01-2017	Certificate issued on 28/03/2018

II. Training/workshop/Seminar etc. Organized

S No.	Name of Programme	Date of Programme	Participants (No.)
1	Exposure training on "Clean meat production and value addition" for SERP, Govt. of Telangana	25 May, 2017	27
2	Goat and poultry meat processing	11-14 July, 2017	18
3	Training on Pork Product processing	31 August - 2 September, 2017	5
4	Training on value added meat product processing	5 - 8 September, 2017	20
5	Training on value added meat product processing	14 -17 November, 2017	6
6	Training on value added meat product processing	15-19 December, 2017	12
7	Training on clean and hygiene chicken production	16 - 19 January, 2018	11



Director NRC on Meat interacting with participants on Goat and poultry meat processing held during 11-14 July, 2017

III. Commercialization of technologies

S. No	Name of Technology/ Know-How	Name of Contracting Party	Mode of Partnership	Date of Licensing	Revenue Earned (Rs)
1	Establishment of value added meat products processing unit	M/s Aye grow Business Solutions, Ernakulum, Kerala	Consultancy	14-04-2017	40,000



S. No	Name of Technology/ Know-How	Name of Contracting Party	Mode of Partnership	Date of Licensing	Revenue Earned (Rs)
2	Establishment of slaughter House for pig	Smt. K. Sulochana, Pig Farmer & Trader, Mahaboobnagar, Telangana.	Consultancy	08-09-2017	40,000
3	Establishment of value added pork products processing unit	Smt. K. Sulochana, Mrs. Rukshitha Pork Pvt. Ltd., Pig Farmer & Trader, Mahaboobnagar, Telangana	Incubatee	08-09-2017	50,000
4	Evaluation of carcass traits and Meat Quality characteristics of Aseel X Brown Layer...	Indbro Research & Breeding Farms Pvt. Ltd., Hyderabad	Contract research	03-01-2017	77,000
5	Evaluation of consumer preference and Meat Quality characteristics of slow and fast growing broiler birds	Indbro Research & Breeding Farms Pvt. Ltd., Hyderabad	Contract research	19-09-2017	1,07,300
6	Establishment of slaughter House for pig	M/S Lavya Mutually aided Co-operative Pig farming and pork marketing society Ltd., Hyderabad	Consultancy	12-02-2018	40,000
7	Manufacturing of processed meat products	M/S Krushuk Mitra, Agro Services Pvt. Ltd., Nasik, MH	Licensing of knowhow	28-02-2018	30,000
8	Establishment of slaughter House for goat	M/S Krushuk Mitra, Agro Services Pvt. Ltd., Nasik, MH	Consultancy	28-02-2018	40,000
9	Establishment of value added goat meat products processing unit	M/S Krushuk Mitra, Agro Services Pvt.Ltd., Nasik, MH	Incubatee	28-02-2018	50,000



**M/s Indbro Research & Breeding Farms Pvt. Ltd.,
Hyderabad signed MoU for carrying out contract research work**



**M/s Rukshitha Pork Pvt. Ltd., Mahbubnagar signed MoU
NRC on Meat for providing consultancy for establish pig slaughterhouse and pork processing unit**



IV. Outreach Activities

S. No	Programme Organized/ participated for Technology Commercialize/ Transfer	No. of Participants	Venue of Event
1	National Oil Seed Mela	More than 500	ICAR-IIOR, Hyderabad
2	Meat Tech Asia 2017	More than 1000	Bengaluru
3	SARAS Exhibition 2017	More than 1000	Hyderabad
4	Poultry Expo 2017	More than 1000	Hyderabad
5	Medaram Jathara	More than 2000	Bhupalpally Dist, Telangana
6	Krishi Unnati Mela	More than 5000	ICAR - IARI, New Delhi



Scientists of NRCM interacting with visitor at Meat Tech Asia 2017 held at Bengaluru during August 28-30, 2017



NRCM exhibited its activities and technologies at Poultry Expo 2017 at Hyderabad



NRCM exhibited its activities and technologies at Sammakka and Sarakka Jatra (Tribal festival) at Medaram, Jaishankar Bhoopalpally district, Telangna



NRCM signed MoU with Sri Venkateshwara College of Pharmacy, Hyderabad



NRCM incubate M/s Rukshitha Pork Pvt. Ltd., Mahbubnagar exhibited its activities at Festival of Innovation and Entrepreneurship 2018 organized at Rashtrapati Bhavan, New Delhi

V. Revenue generated

Sr. No.	Type of service	Number	2016-17
1.	Licensing Technical Knowhow	1	0.30
2.	Consultancy	6	2.60
3.	Contract Research	2	1.84
4.	Trainings	7	1.22
5.	Analytical services		7.17
6.	Sale of meat products	-	2.07
Total			15.20



7. Development of smart packaging nano-sensor for monitoring quality and safety of meat

Funding Agency : DBT, Govt. of India
Principal Investigator : Kandeepan.G
Co-Investigators : Suresh Devatkal, M.R.Vishnuraj

In spite of good manufacturing practices, quality and safety norms followed at various manufacturing plants, the estimated shelf life of a product gets decreased due to negligence or break down in cold chain/interrupted power supply eventually resulting in spoiled meat and meat products. If indicator sensor and time temperature indicators are made available to monitor quality and safety of meat and meat products, it would benefit both manufacturers and consumers. While, the manufacturers can track quality and remove unsatisfactory meat and meat products before they find their place in the display cabinets for sale. The consumers can confidently purchase meat and meat products without any doubt over the quality simply by observing colour of the indicator in the packaged product. Therefore, there is a desperate need to develop smart packaging sensors for monitoring quality and safety of meat and meat products in supply chain. The project was initiated from January, 2018 with an outlay of Rs. 42.368 lakhs. The project JRF has been recruited, while equipment and chemicals purchase is in progress. Standardization of the protocol for the preparation of Time Temperature Indicator (TTI) is being carried out.

Other Institute research activities

Principal Investigator : B. M. Naveena

Effect of low-voltage electrical stimulation on the quality and proteome changes in sheep meat

Low-Voltage Electrical Stimulation (42v, 0.6 Amps) accelerated the onset and completion of rigor mortis in ES sheep carcasses and significantly increased the tenderness. The proteomic analysis using 2-DE and MS identified few important proteins viz, tropomyosin, ubiquinone, calcitonin gene-related peptide 1, calcium-binding protein, calcium channel protein and cytochrome c oxidase that are responsible for tenderization of sheep meat due to electrical stimulation and can be used as markers for tenderization. Low voltage electrical stimulation (LVES) can be used as an effective post-slaughter intervention for improving the tenderness and other quality characteristics of spent sheep meat.

Meat quality and proteomic changes in sheep (*Ovis aries*) slaughtered according to traditional halal slaughter without stunning versus slaughter with electrical stunning

Investigated the changes in blood biochemical parameters, meat quality and proteomic profile of sheep subjected to either pre-slaughter electrical stunning followed by slaughter (ST) or traditional halal slaughter without stunning (NST). Higher ($P < 0.05$) blood loss was observed in NST sheep, whereas blood glucose revealed hyperglycemia in electrically stunned animals. Higher ($P < 0.05$) pH, water holding capacity, cooking loss and Warner-Bratzler shear force were observed in meat from stunned sheep. Comparison of muscle proteome of ST and NST samples by In-gel digestion and MALDI-TOF/TOF MS analysis revealed 46 differentially ($P \leq 0.05$) expressed proteins. This understanding of proteomic changes in sheep slaughtered with and without stunning have the potential to act as possible signature for animal welfare index.

Principal Investigator : Kandeepan G.

Development of dry pet food from buffalo offals

Buffalo offals such as variety meat and tripe are underutilized by-products constituting 2.5% and 15% live weight of the animal respectively. Proper utilization of these by-products would fetch additional income to the entrepreneurs in addition to supplying nutritious food for the pets. Therefore, a research was undertaken with an objective to develop dry pet food from buffalo offals. The formulation and process protocol were optimized for the development of dry pet food from offal meal derived from buffalo liver, lungs, heart and tripe in combination with multi-cereal floor, whole egg liquid, water, skim milk powder, fat, wheat bran, salt, baking powder, vitamin supplements and preservatives. The standardized formulation constitutes offal meal 25%, multicereal flour 25%, water 20%, whole egg liquid 15%, skim milk powder 5%, fat 5%, wheat bran 2%, salt 1.8%, baking powder 0.5%, citric acid 0.5%, potassium sorbate 0.1%, sodium ascorbate



0.05% and vitamin mix 0.05%. A batter was prepared in the food processor and the cookies were formed with preformed moulds. Then the cookies were cooked in a convection oven. The optimized cooking temperature and duration is 160°C for 12 min for 2.5 g uncooked cookies and 160°C for 22 min for 6.5 g uncooked cookies both with thickness of 0.5cm. The average yield of dry pet food from buffalo offals was 77.32%. The cooked products showed on an average 26% reduction in height of the dry pet food. The proximate composition of dry pet food showed mean values of 1.71% moisture, 16.15% fat, 42.66% protein and 5.16% ash. The mean instrumental L*, a*, b* color scores observed were 43.66, 10.34, and 17.75 respectively. The dry pet food showed mean shear force value of 29.55N. The mean microbial load recorded in terms of SPC was 1 log cfu/g in cooked dry pet food. The dry pet food from buffalo offals also showed a mean TBA value of 0.783 and pH of 5.51. The sensory evaluation of the product on 8-point descriptive scale indicated a mean scores of 7.07, 6.83 and 7.01 for appearance, texture and meat flavor intensity, respectively. The feeding trial with dogs showed very good acceptability with no observed gastrointestinal disturbances.



Principal Investigator : Suresh Devatkal

Evaluation of consumer preference and meat quality characteristics of slow and fast growing broiler birds (Indbro- Contract Research project)

A detailed study conducted on carcass yield, meat quality characteristics and sensory acceptance of meat of slow and fast growing broiler birds. Slow growing broiler breast meat contained significantly ($P < 0.05$) lower total fatty acid and saturated fatty acid content. Further slow growing broiler breast meat had an optimum ratio of saturated fatty acids to monounsaturated fatty acid (SFA: MUFA was 1:1). Unsaturated fatty acids were also higher in slow growing broiler breast meat. Hence, slow growing broiler breast meat is having healthier fatty acid composition. Consumer preference test showed that a significant ($P < 0.05$) percentage (67%) of consumers preferred the meat and meat products prepared from Indbro slow growing broiler meat and only 32% consumers preferred the meat and meat products prepared from commercial fast growing broiler meat.

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2. Review/Technical/Popular articles

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3. Presentations in Conferences/Symposia/Seminar

a. Lead papers/invited lectures

Banerjee, R., and Naveena, B. M. (2018). Development of Functional Meat Products for Catering to Health Conscious Consumers. Collaborative training programme of MANAGE and ICAR-NRC on Meat on "Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation". February 12-21, 2018. ICAR-NRC on Meat, Hyderabad.

Banerjee, R., Naveena B. M., and Muthukumar M. (2018). Advances in Chilling and Freezing of meat: Industrial Applications. Collaborative training programme of MANAGE and ICAR-NRC on Meat on "Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation". February 12-21, 2018. ICAR-NRC on Meat, Hyderabad.

Banerjee, R., Naveena B. M., and Muthukumar M. (2018). Innovations in Processing of Value Added Meat Products. Collaborative training programme of MANAGE and ICAR-NRC on Meat on "Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation". February 12-21, 2018. ICAR-NRC on Meat, Hyderabad.

Banerjee, R., Naveena B. M., and Muthukumar M. (2018). Start-up Initiatives in Agriculture and Allied Sectors. Collaborative training programme of MANAGE and ICAR-NRC on Meat on "Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation". February 12-21, 2018. ICAR-NRC on Meat, Hyderabad.

Barbuddhe, S.B. (2018). Emerging microbial threats in India: Status, preparedness, and outlook
Invited talk presented at International Conference on "Emerging Microbes & Infection & its Impact on Public Health" organized by Central India Institute of Medical Sciences, Nagpur, 9th February, 2018.

Barbuddhe, S.B. (2018). Genomics and zoonoses: A case study-The genome landscape in *Listeria* at National training program on "Genomics and Zoonoses research" under the aegis of ICAR-Niche Area of Excellence on "Centre for Zoonoses" Department of Veterinary Public Health, Nagpur Veterinary College MAFSU, Nagpur organized during March, 6 -10, 2018 on 8 March, 2018.

Barbuddhe, S.B. (2018). Laboratory techniques in Meat microbiology and veterinary public health" at Training programme on "Meat quality testing and molecular techniques for detection of meat adulteration" for Veterinarians under National Livestock Mission Project organized by ICAR-National Research Centre on Meat, Hyderabad on 18 January, 2018.

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- Barbuddhe, S.B. (2018). Public health concerns in meat sector” at Training programme on “Recent developments in small ruminant rearing, meat quality control and value addition” for Veterinarians under National Livestock Mission Project organized by ICAR-National Research Centre on Meat, Hyderabad on 21 December, 2017.
- Barbuddhe, S.B. (2018). Rapid methods for identification of food borne pathogens. Training manual of “Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation” organised by ICAR-NRC on Meat, Hyderabad, 12-21 February, 2018, pp. 102-109.
- Barbuddhe, S.B. (2018). Sustainable livelihood through small scale meat production and processing” at National Institute of Agriculture Extension Management, Hyderabad for the extension functionaries of State Department of Animal Husbandry on 5th October, 2018.
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- Kalpana, S. (2018). Detection of Veterinary Drug residues in Meat in National Livestock Mission sponsored short course manual on “Recent developments in small ruminant rearing, meat quality control and value addition”. ICAR-NRC Meat, Hyderabad.



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- Kalpana, S. (2018). Veterinary Drug Residues in meat: techniques and regulations for ensuring consumer safety in National institute of Agricultural extension sponsored short course manual on "Entrepreneurship Development in meat value chain: A drive for sustainable animal production and employment generation". ICAR-NRC Meat, Hyderabad.
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- Kandeepan, G. (2018). Scope and importance of value addition of yak products. Workshop on Yak resources towards doubling highland farmer's income, March 14-16, 2018. ICAR-National Research Centre on Yak, Dirang in collaboration with ICAR-National institute of research on jute and allied fibre technology, Kolkata.
- Kandeepan, G., Vishnuraj, M.R., Kalpana, S., and Reddy, P.B.(2017). Recent development in packaging of meat and meat products. In training manual on 'Recent developments in small ruminant rearing, meat quality control and value addition' published under 'National Livestock Mission' Page 40-60
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- Kulkarni, V.V., Banerjee, R., and Muthukumar, M. (2018). Greening of Meat Sector: Strategies for Environmental Protection. ICAR sponsored CAFT training on "Advances in poultry production and its impact on changing global scenario". February 7-27, 2018. Department of Poultry Science. Veterinary College and Research Institute, Namakkal.
- Muthukumar, M. (2018). Quality and safety of meat. Dietetic day celebration organised by Indian Diets Association, Telangana Chapter, 10 January, 2018, Aster Hospital, Ameerpet, Hyderabad.
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NRC on Meat on Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation, February 12-21, 2018. ICAR-NRC on Meat, Hyderabad.

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- Muthukumar, M., Pathak, V., Kandeepan, G., Rathod, K.S., Thomas, R. and Kulkarni, V.V. (2017). Statewise yield and value of carcass and byproducts of goat. National Seminar on Small ruminants: National scope on upscaling production to products value addition and their safety, November 9-10, 2017. ICAR-CIRG, Madhura, UP
- Muthukumar, M., Ramakrishna, C., Devatkal, S., Reddy, P.B., Varalakshmi, K. and Kulkarni, V.V. (2018). Impacts of buffaloes slaughter and meat export policy on the livestock production systems, food security and eco-balance. 9th Asian Buffalo Congress, organized by ISBD, during 1-4 February, 2018 at CIRB, Hisar.
- Naveena, B.M. (2017). Value addition in meat and poultry” during Refresher Training Programme on “Value addition opportunities in Agri and Allied Sectors” held at MANAGE, Hyderabad from 21-24 August, 2017.
- Naveena, B.M. (2018). Capacity building programmes and employment opportunities in meat sector” on 19th March, 2018 during Faculty Development Programmes on Rural Entrepreneurship at Mahatma Gandhi University, Nalgonda, Telangana.
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- Naveena, B.M. and Banerjee, R. (2018). Understanding meat quality and processing technologies for tenderization of meat. Collaborative training programme of MANAGE and ICAR-NRC on Meat on “Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation” from 12-21 February, 2018, pp. 32-38.
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Reddy, P.B. (2017). Feeding approaches for improving productivity in Sheep. In training manual on 'Recent developments in small ruminant rearing, meat quality control and value addition' published under 'National Livestock Mission' Page 6-9

Reddy, P.B. (2017). Organic livestock production and certification in India. In training manual on 'Recent developments in small ruminant rearing, meat quality control and value addition' published under 'National Livestock Mission' Page 86-95

Reddy, P.B.(2017). Status of sheep production in Telangana. In training manual on 'Recent developments in small ruminant rearing, meat quality control and value addition' published under 'National Livestock Mission' Page 1-5

Reddy, P.B., and Kaje, V. (2018). Designer meat production – Nutritional and nutrigenomic approach. In Training manual on 'Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation'. Page 22-27.

Reddy, P.B., Ramana,D.B.V., and Pankaj, P.K. (2017). Protocols for organic livestock production and certification in India. In training manual on 'Tools on Monitoring, Evaluation and impact assessment of rain fed technologies and development programmes'. ICAR Short course, CRIDA, 1-10 November, 2017, Page 148-153.

Reddy, P.B., Ramana,D.B.V., Pankaj, P.K.,and Kaje, V. (2018). Entrepreneurial opportunities in organic livestock production and certification in India. In Training manual on 'Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation'. Page 7-12.

Vaithiyanathan, S. and Vishnuraj, M.R. (2018). Fraudulent adulterations in meat and its detection using molecular techniques. In Training manual on 'Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation'. Page 153-170.

Vaithiyanathan, S. and Vishnuraj, M.R. (2017). DNA based molecular techniques for detection of meat adulteration. In training manual on 'Recent developments in small ruminant rearing, meat quality control and value addition' published under 'National Livestock Mission' Page 61-69.

Vaithiyanathan, S. and Vishnuraj, M.R. (2017). Meat species identification based on various PCR platforms and its field applications. In compendium of the National Seminar on “Small

Ruminants: National Scope on Upscaling Production to Products Value addition and their Safety” at ICAR- CIRG, Makhdoom on 9-10 November, 2017. LLP6 pp 182-185.

Varalakshmi, K., Reddy, P.B., Muthukumar, M., Naveena, B.M., and Girish, P.S. (2018) Economics of meat production and processing. In: Training manual on 'Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation'. Page 153-170.

Vishnuraj, M.R., Vaithiyanathan, S., Kandeepan, G., and Kalpana, S. (2018) Animal handling, transport policies and welfare indicators affecting meat quality. In Training manual on 'Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation'. Page 153-170.

b. Abstracts

Akhunji, B., Chaudhari, S.P., Bhate, R., Kurkure, N.V., Barbuddhe, S.B., Raut, S.S. and Deshpande, S. (2017). Orientia tsutsugamushi infection in human and rodent population targeting 47kDa gene. Poster presented at the “XV Annual Conference of IAVPHS and National Symposium on Intersectoral Approaches to Combat Zoonoses: Strategies and Challenges” organized by College of Veterinary Science, Sri Venkateswara Veterinary University, Tirupati, 11-13 October, 2017.

Banerjee, R., Naveena, B.M., Muthukumar, M. and Kulkarni, V.V. (2017). Value Addition and Entrepreneurship Development: Role of NRC on Meat-Agribusiness Incubator (ABI). International Conference on “Technologies for value addition in food products”. July 20-21, 2017, Hyatt Regency, Chandigarh.

Muthukumar, M., Pathak, V., Kandeepan, G., Rathod, K.S., Thomas, R. and Kulkarni, V.V. (2017). Statewise yield and value of carcass and byproducts of goat. National Seminar on Small ruminants: National scope on upscaling production to products value addition and their safety, November 9-10, 2017. ICAR-CIRG, Madhura, UP

Muthukumar, M., Ramakrishna, C., Devatkal, S., Reddy, P.B., Varalakshmi, K. and Kulkarni, V.V. (2018). Impacts of buffaloes slaughter and meat export policy on the livestock production systems, food security and eco-balance. 9th Asian Buffalo Congress, organized by ISBD, during 1-4 February, 2018 at CIRB, Hisar.

Naveena, B. M., Suresh, K. D. and Banerjee, R. (2017). Purification and characterization of antioxidant peptides from spent hen meat. XXXIV Annual Conference on Innovations for safe and sustainable poultry production: IPSACON, November 28-30, 2017, ICAR-NIANP, Bengaluru.

Pal, P., Avasthe, R.K., Islam, R., Kumar, B. and Chatlod, L.R. (2017). Prevalence and risk factors of gastrointestinal parasites in ruminants of organized farms in Sikkim, India. Pp-57 In: Compendium, XI National conference of Indian Academy of Tropical Parasitology on Food hygiene, safe environment and sanitation towards freedom from parasitic diseases. 6-8th September, 2017, Sikkim Manipal Institute of Medical Sciences, Tadong, Sikkim.

Sahana, M., Fairuze, N., Vaithiyanathan, S., Ruben, W., Sudarshan, S., Namratha, K.B. and



Priyanka, V.S. (2017). A comparison of dna extraction methods for fats and rendered fats analysis at National Seminar on Food Adequacy and Climate Change: Strategies for sustainable food production at AMST, Trissur on November, 3-4, 2017.

Vaithiyanathan, S., Srinivas, K., Reddy, N., and Vishnuraj, M.R. (2017). Application of Low Cost Density (LCD) Meat Array to Detect Misrepresentation of Meat Species in Haleem. Abstract to be presented in the National Seminar on "Small Ruminants: National Scope on Upscaling Production to Products Value addition and their Safety" at ICAR- CIRG, Makhdoom on 9-10 November, 2017. LOS8 pp199-200.

Vaithiyanathan, S., Vishnuraj M.R., Reddy, N., and Kulkarni, V.V. (2018). Food Forensics: Application of DNA technology to check misrepresentation of species in illegally sold meat. Abstract presented in the International conference on bioengineering on health and environment- icbhe'18 held at Chennai on 8-10 January, 2018

Vaithiyanathan, S., Vishnuraj, M.R., Reddy, N., Kulkarni, V.V. and Patil, N.V. (2018). Detection of camel (*Camelus dromedarius*) meat from suspected samples using species specific PCR-Restriction Fragment Length Polymorphism (RFLP) assay. Abstract presented in the International conference on bioengineering on health and environment- icbhe'18 held at Chennai on 8-10 January, 2018.

4. Training manuals

Kadirvel, G., Reddy, P.B., Thomas, R., Doley, S., Muthukumar, M., Devatkal, S.K., Girish, P.S., and Banerjee, B.B. (2017). Training manual on ' Capacity building for stake holders on hygienic meat production and processing in north eastern region of India', for the training programme conducted at ICAR RC for NEHR, Barapani, Meghalaya from 1st to 23rd August, 2017.

Naveena, B.M., Muthukumar, M., Rituparna, B., and Suresh, K.D. (2017). Training Manual on "Development of value added meat products", held at NRC on Meat from 11-14, July, 2017.

Naveena, B.M., Muthukumar, M., Rituparna, B., Phand, S. (2018). Entrepreneurship development in meat value chain: A drive for sustainable animal production and employment generation. Training manual for collaborative training programme of MANAGE and ICAR-NRC on Meat. 12-21 Feb, 2018.

Reddy, P.B., Muthukumar, M., Kandeepan, G., Kalpana, S., and Vishnuraj, M.R. (2017). Training manual on 'Recent developments in small ruminant rearing, meat quality control and value addition' published under 'National Livestock Mission' training programme to veterinarians from 20-23 December, 2017.

Vaithiyanathan, S., Vishnuraj, M.R., and Reddy, P.B.(2017). Technical manual on 'DNA based methods for meat species & sex identification' published under national livestock mission, ICAR- NRC on Meat.

5. Folders/Brochure

- Barbuddhe, S.B., Chatlod, L.R., Ramakrishna, C. and Kulkarni V.V. (2017). Booklet on zoonoses on occasion of World Zoonoses Day, 2017, ICAR-National Research Centre on Meat, Hyderabad.
- Kalpana, S., Kandeepan, G., Muthukumar, M., Vishnuraj, M.R., and Reddy, P.B. (2017). Technical brochure on 'Antimicrobials of veterinary importance- Classification and mode of action'. Published under National Livestock Mission.
- Kalpana, S., Kandeepan, G., Ramakrishna, C., Vishnuraj, M.R., and Reddy, P.B. (2017). Technical brochure on 'Judicious use of antimicrobials in veterinary practice'. Published under National Livestock Mission.
- Kalpana, S., Kandeepan, G., Vishnuraj, M.R., and Reddy, P.B. (2017). Technical brochure on 'Codex standards for veterinary drugs in foods of animal origin'. Published under National Livestock Mission.
- Muthukumar, M., Banerjee, R. and Vishnuraj, M.R. (2017). ICAR-NRC on Meat – at a glance. ICAR-NRC on Meat publication.
- Naveena, B.M. (2017). XII Plan Achievements of ICAR-NRC on Meat (2012-17).
- Vaithiyanathan, S., and Vishnuraj, M.R. (2018). Information brochure on 'Do's and don'ts while collection and forwarding meat samples for species identification to MSIL. Published under National Livestock Mission.

6. Books and Book Chapters

- Banerjee, R., Verma, A. K. and Siddiqui, M. W. (2017). Natural Antioxidants: Applications in Foods of Animal Origin. Apple Academic Press, Waretown, NJ, USA. ISBN: 978-1771884594.
- Banerjee, R., Verma, A.K., Siddiqui, M.W., Naveena, B.M. and Kulkarni, V.V. (2017). Potential Applications of Natural Antioxidants in Meat and Meat Products. In: Natural Antioxidants: Applications in Foods of Animal Origin. Rituparna Banerjee, Arun K Verma and Mohammed Wasim Siddiqui (Eds.). Apple Academic Press, Waretown, NJ, USA, pp. 95-140.
- Girish, P.S. (2017). Collection and utilization of pig byproducts. In: Pig production and processing. Published by Jaya Publishing House, Delhi, 443 - 446.
- Girish, P.S. (2017). Method for disposal of waste generated from pig slaughter house. In: Pig production and processing. Published by Jaya Publishing House, Delhi, 461 - 465.
- Girish, P.S. (2017). Production of shelf stable ready-to-eat pork products using retort processing technology. In: Pig production and processing. Published by Jaya Publishing House, Delhi, 365 - 371.
- Girish, P.S., Sen, A., and Karabasanvar, N. (2017). Marketing channel of pigs and pork in north eastern region. In: Pig production and processing. Published by Jaya Publishing House, Delhi, 425 - 429.



- Girish, P.S., Thomas, R., and Sharma, D.K. (2017). Economics of pig slaughter and value addition to pork. .In: Pig production and processing. Published by Jaya Publishing House, Delhi, 417–424.
- Thomas, R., and Girish, P.S. (2017). Pig slaughterhouse planning. In: Pig production and processing. Published by Jaya Publishing House, Delhi, 287 – 293.
- Thomas, R., and Girish, P.S. (2017). Requirements for setting up a pig abattoir. In: Pig production and processing. Published by Jaya Publishing House, Delhi, 295– 298.
- Verma, A. K., Banerjee, R., and Rajkumar, V. (2017). Antioxidant Dietary Fiber: An Approach to Develop Healthy and Stable Meat Products. In: Natural Antioxidants: Applications in Foods of Animal Origin. Rituparna Banerjee, Arun K Verma and Mohammed Wasim Siddiqui (Eds.). Apple Academic Press, Waretown, NJ, USA, pp. 299-342.

PARTICIPATION IN TRAINING/SEMINAR/ CONFERENCES/ SYMPOSIA/WORKSHOP

- Dr. S. B. Barbuddhe attended National Symposium on "Intersectoral Approaches to Combat Zoonoses: Strategies and Challenges" held at College of Veterinary Science, Sri Venkateswara Veterinary University, Tirupati, during 11 - 13 October, 2017 and presented a lead paper.
- Dr. S. B. Barbuddhe attended stakeholders workshop on "Integrated one health approaches for cysticercosis control in India and Nepal" held in New Delhi during November 16-17, 2017.
- Dr. S. B. Barbuddhe attended National Interactive workshop on OIE-PVS evaluation organized by Dept. of Animal Husbandry, Dairying and Fisheries, Min. of Agriculture and Farmers Welfare, Govt. of India at NASC Complex, New Delhi during 15-16 December, 2017.
- Dr. S. B. Barbuddhe attended International Conference on "Emerging Microbes & Infection & its Impact on Public Health" held at Central India Institute of Medical Sciences, Nagpur on 9 February, 2018.
- Dr. S. B. Barbuddhe attended first meeting of FAO funded ICMR-ICAR project ICAR-ICMR Collaborative Project on Capacity building for integrated surveillance of antimicrobial resistance (AMR) in pathogen/commensals in food producing animals, food of animal origin and their environment and foodborne pathogens in humans held at ICMR Head Quarters, New Delhi on 15 March, 2018.
- Dr. S. B. Barbuddhe participated in the Krishi Unnati Mela organized at ICAR-IARI, New Delhi during 16-18 March, 2018.
- Dr. S. B. Barbuddhe attended National Symposium on "Thrust areas of relevance to Livestock research" held at National Institute of Animal Biotechnology, Miyapur, Hyderabad. during 27-28 March, 2018.
- Dr. P. Baswa Reddy participated in APEDA Organic livestock committee meeting for finalizing the revised guidelines for organic livestock production and certification under NPOP. Krishi Bhawan on 4 May, 2017.



- Dr. P. Baswa Reddy participated in the Consultation meeting of the State Coordination committee (SCC) for Andhra Pradesh on Doubling of farmers Income by 2022 at IIOR on 25 October, 2017.
- Dr. P. Baswa Reddy participated in 19th Organic World Congress and conference on 'An organic world through an organic India' organized by IFOAM at India Expo Centre, Greater Noida during 9-11 November, 2017.
- Dr. P. Baswa Reddy participated in Workshop on 'Livestock based livelihoods' organized Society for Elimination of Rural Poverty (SERP) at Hyderabad on 6 March, 2018.
- Dr. P. Baswa Reddy participated in Workshop on 'Development of food processing industry in Livestock sector in Telangana'. Organized by the Animal Husbandry department at Hyderabad on 13 March, 2018.
- Dr. P. Baswa Reddy participated in the seminar on "Multiplying Farmers' Income: Opportunities in Animal Husbandry and Processing of Organic Pig and Fish Products-Potential for Exports-Focus North East" organized by PHD Chamber of Commerce and Industry at NEDFI, Guwahati on 31 October, 2017.
- Dr. S. Kalpana participated and presented in 3 days International Conference on "New Insights and multidisciplinary approaches in Toxicological Studies" during 36th Annual Conference of Society of toxicology (STOX) held at Amity University, August 3-5, 2017.
- Dr. S. Kalpana attended 5 days FSSAI sponsored programme -Training of Trainers (ToT) Program on Veterinary Drug Residues held at CALF, NDDDB, Anand, Gujarat during 18-22 September, 2017.
- Dr. S. Kalpana attended one day workshop organized by Waters Corporation on "Liquid Chromatography Chemistries" at Hitec City, Hyderabad, Telangana on 27 October, 2017.
- Dr. S. Kalpana participated in 2 days National symposium on "Role of women veterinarians in enhancement of livestock productivity, health and welfare" held at PVNR Telangana Veterinary University, Hyderabad, Telangana during 21-22 November, 2017.
- Dr. S. Kalpana undergone one day workshop organized by the Veterinary and Animal Husbandry Department, Government of Telangana on "Current Status and future strategies to counter anti-microbial resistance in livestock" held at PVNR Telangana Veterinary University, Hyderabad, Telangana on 24 January, 2018.
- Dr. Kandeepan G. attended training program on "Advances in applications of nanotechnology", held at ICAR-CIRCOT, Mumbai during 11-15 September, 2017.
- Dr. M. Muthukumar attended the meeting on "Processing characteristics of Agri produce and Animal and fisheries breeds" conducted by Council in collaboration with Ministry of Food Processing Industries, Govt. of India on 16 June, 2017 at Krishi Bhavan, New Delhi.

- Dr. M. Muthukumar attended the meeting related to fixation of quantities of boneless buffalo meat and edible offal derived per buffalo livestock convened by Dept. of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Govt. of India at Krishi Bhavan, New Delhi on 28 July, 2017.
- Dr. M. Muthukumar attended the vigilance awareness meeting organized under the chairmanship of Secretary, ICAR on 24 August, 2017 at NIANP, Bengaluru.
- Dr. M. Muthukumar presented the final report of the project work entitled "Effect of buffalo slaughter and meat export policy" at APEDA head quarter, New Delhi on 12 September, 2017.
- Dr. M. Muthukumar attended 5 days trainers training programme on "Veterinary drug residues including antibiotics" organized by FSSAI at Export Inspection Agency, Mumbai during 10-14 October, 2017.
- Dr. M. Muthukumar participated in the "Food Processing Summit" organised by AP Food Processing Society, Dept. of Industries, Govt. of Andhra Pradesh at Vijayawada, Andhra Pradesh on 16 October, 2018.
- Dr. M. Muthukumar attended National Seminar on Small ruminants: National scope on upscaling production to products value addition and their safety, organized by ISSGPU, at CIRG, Madhura, UP during 9-10 November, 2017.
- Dr. M. Muthukumar participated the 9th Asian Buffalo Congress, organized by ISBD, at CIRB, Hisar during 1-4 February, 2018.
- Dr. M. Muthukumar attended the National Conclave on Scientific co-operation on food safety and applied nutrition held at FSSAI, New Delhi on 5 February, 2018.
- Dr. B. M. Naveena attended meeting for finalization of EFC/SFC document of ICAR-NRC on Meat held at ICAR, Krishi Bhawan, New Delhi on 1-2 June and 19-20 July, 2017.
- Dr. B. M. Naveena attended Mid-Term Review meeting of ICAR-Regional Committee-II held at ICAR-CIFRI, Barrackpore, West Bengal on 13 November, 2017.
- Dr. B. M. Naveena participated and presented abstract at XXXIV Annual Conference on "Innovations for safe and sustainable poultry production" (IPSACON-2017) at Bengaluru, India during 28-30 November, 2017.
- Dr. Rituparna Banerjee attended International Conference on "Technologies for value addition in food products" organized by Selectbio at Hyatt Regency, Chandigarh during July 20-21, 2017.
- Dr. Rituparna Banerjee completed 5 days National Training Programme on "Genomics and Zoonoses Research" organized by the ICAR-Niche Area of Excellence Project on "Centre for Zoonoses" at Nagpur Veterinary College, Nagpur during 6-10 March, 2018.



- Dr. S. Vaithiyanathan, Dr Suresh Devatkal, Dr. Girish Patil S. and Dr. M. R. Vishnuraj attended the 4 days Training program on Laboratory Quality Management System held at BIS, Chennai during 7-10 November 2017.
- Dr. S. Vaithiyanathan attended the IX Asian Buffalo Congress at ICAR-CIRB, Hisar during 1-4 February 2018 and participated in the panel discussion with farmers.
- Mrs. K. Varalakshmi attended training on "Impact Assessment of Agricultural Research and Technologies" held at NAARM, Rajendra nagar, Hyderabad during 12-16 September, 2017.
- Dr. M. R. Vishnuraj undergone 2 days Internal Auditor Training as per the ISO 9001-2015 standards, at ICAR-NRC on Meat, in consultation with Chinmaya Management Consultants, Hyderabad during 18-19 August, 2017.
- Dr. M. R. Vishnuraj undergone one week Skill development program (SDP) in Wildlife Forensics, at CSIR-CCMB, LaCONES, Hyderabad, durning 25 September.
- Dr. M. R. Vishnuraj attended three days in World Food India-2017, at New Delhi during 3-5 November, 2017.
- Dr. M. R. Vishnuraj attended 11th edition of Poultry India Exhibition-2017, at Hyderabad, during 22-25th November, 2017.
- Dr. M. R. Vishnuraj participated in International Conference of Bioengineering in Health and Environment (ICBHE-2018), organized by Satyabhama University, Chennai during 8-10 January, 2018.
- Dr. M. R. Vishnuraj and Dr. Rituparna Banerjee participated in two days National workshop on "Revisiting Foundation Course for Agricultural Research Service" organized by ICAR- NAARM on 15-16 March, 2018 .
- Dr. Girish Patil S. attended the training programme on 'Host - Pathogen Intractions' organized at Nagpur Veterinary College, MAFSU, Nagpur during 9 to 13 January, 2018.

AWARDS AND RECOGNITIONS

- Dr. B.M. Naveena, Senior Scientist has been selected as a MEMBER, National Academy of Sciences (NASI), India 2017.
- Dr. B.M. Naveena, Senior Scientist has been conferred with the FELLOWSHIP of Indian Poultry Science Association (IPSA) since November 2017



- Dr. Kandeepan. G., Scientist (Sr. Scale) was conferred with Outstanding Scientist Award at Venus International Research Awards (VIRA 2017) organized by Venus International Foundation, Chennai.



MEETINGS/EVENTS ORGANISED/ PARTICIPATED

11th Research Advisory Committee Meeting of the Centre

The 11th Research Advisory Committee meeting of ICAR - National Research Centre on Meat, Hyderabad was held on 8th August 2017. The meeting was chaired by Dr. J.K. Malik, Former Joint Director, IVRI and attended by RAC members, Dr. V.V. Kulkarni, Director, NRC on Meat, Dr. B.S. Prakash, ADG (AN and P), Dr. George T. Oommen, Dr. Mineswar Hazarika, Dr. U.K. Pal. Dr. B.M. Naveena acted as member secretary.



11th RAC meeting of ICAR-NRC on Meat held

Visit of delegation of Cornell University, USA

Student delegation of Cornell University, New York, USA along with students of University of Agricultural Sciences, Dharwad and Assam Agricultural University, Guwahati visited ICAR – National Research Centre on Meat, Hyderabad on 8th January 2018. Visit was coordinated by Satguru Consultants, Hyderabad. Delegation had detailed discussion with Director and Scientists of the Centre regarding meat industry in India and activities of the Institute. It was followed by visit to different laboratories and facilities of the centre.



Cornell University delegation along with Director and Staff

Hon. Animal Husbandry and Sericulture Minister Karnataka state visited the Institute

Hon. Animal Husbandry and Sericulture Minister, Karnataka state Shri A. Manju visited ICAR- NRC on Meat, Hyderabad along with the Animal Husbandry officials of Karnataka on 10th August 2017. Managing Director of Sheep and Goat development federation of Telangana Dr Laxma Reddy also accompanied the minister. Dr V.V. Kulkarni, Director, NRC on Meat welcomed the delegation and took them around different labs, experimental slaughter house and meat processing unit. An interactive meeting was held with all the scientists of the centre to apprise the minister about different ongoing and completed activities. Hon. Minister appreciated the efforts of the centre towards development of meat sector in the country. He requested the Director for technical guidance for development of sheep and goat sector and establishment of slaughter houses for clean meat production in Karnataka.



Scientists of the Centre along with Shri A Manju, Karnataka state Animal Husbandry and Sericulture minister on 10th August 2017

OIE-PVS Team visited the Institute

The OIE-PVS mission team for evaluation of Performance of Veterinary Services visited ICAR – National Research Centre on Meat, Hyderabad on 27th February 2018. The OIE (Office International des Epizooties) team comprising of Dr. Jonathan and Dr Caitlin Holley along with officials from Department of Animal Husbandry of Telangana state visited the laboratories of the Centre and had interaction with scientists regarding research activities being undertaken at the Centre. Dr. S. Vaithiyanathan, Acting Director welcomed the team and briefed about Centre's activities. A detailed presentation was also made on Centre's activities.



Interaction of OIE team with Scientists of the Centre



OIE team along with Scientists of the Centre

Hon'ble Vice President of India Shri Venkaiah Naidu urged Scientists to make Agriculture sustainable and viable

Hon'ble Vice President of India, Shri M. Venkaiah Naidu interacted with Scientists of different ICAR Institutions situated in Hyderabad in the Interactive meet on, 'Doubling of farmers' income' on 31st March 2018. Meet was held at Indian Institute of Rice Research, Rajendranagar. Dr. Trilochan Mahapatra, Secretary, DARE & Director General, ICAR, Dr A. K. Singh, DDG (CS), Directors and Scientists of different ICAR Institutions of ICAR located at Hyderabad were present during the occasion. Padmashree Dr. S. V. S. Sastry and Padmashree Dr. Siddiqui also graced the meet. Dr. Ch. Srinivasa Rao, Director, NAARM welcomed the gathering. DG, ICAR gave an overview of

achievements of ICAR and the initiatives taken by ICAR in doubling of farmers income. Directors of ICAR Institutes located in Hyderabad apprised on initiatives taken by them and the steps needed to be taken in national level for doubling of farmers' income in their respective commodity. Hon. Vice President patiently listened to inputs and interacted with the audience. He shared a data from MANAGE study which indicated that farmers having backyard poultry and dairying never committed suicide.



Shri. Venkaiah Naidu, Hon'ble Vice President of India addressing the participants

In his concluding remarks Hon. Vice President urged scientists to work for making agriculture viable, sustainable and remunerative. He also advised scientists to work for increasing productivity and production of agricultural crops; take steps to propagate outcome of research to farmers; undertake market research; popularize E – National Agricultural Marketing portal; spend half of the time in field with the farmers and promote allied agricultural activities among farmers. Dr. S. R. Voleti, Director, IIRR delivered vote of thanks.

Foundation day celebrated

ICAR-National Research Centre on Meat (NRCM), Hyderabad celebrated its 11th Foundation Day on 22nd February, 2018. Dr. R.N. Chatterjee, Director, ICAR-Directorate of Poultry Research, Hyderabad graced the celebrations as Chief Guest for the inaugural function. Dr. S. Vaithiyanathan, Director (Acting), NRCM welcomed the guests and highlighted the achievements of the Centre. He narrated the achievements of the Centre and its role in promoting research and extension in meat sector, particularly the needs of the farmers and entrepreneurs namely, meat processors, retailers and butchers by conducting training/awareness programmes. The Institute also promotes entrepreneurship through its agribusiness incubator. He gave a chronological account of achievements of the Centre. The Centre has developed technologies for species identification of meat and established service laboratory for species identification. The Centre has also established two rural feed processing units in Nellore and Mahabubnagar districts to cater to



feed requirements of the sheep farmers, developed protocols for organic meat production, developed traceability model for Indian buffalo meat industry, undertaken baseline survey on chemical residues in meat and meat products

The Guest-of-Honour, Dr. Md. Nadeem Fairoze, Professor & Head, Veterinary College, KVAFSU, Bangalore appreciated the progress made by the Centre since its inception. He opined that activities of the Institute were extremely relevant in view of changing approach of the country towards meat production and consumption. Dr. R.N. Chatterjee lauded the efforts made in technology transfer by the Institute. He emphasized the importance of value addition for enhancing farmers' income. He appreciated the efforts made in different research areas like meat traceability, species identification and organic meat production. He mentioned about constant rising of the export competitiveness of Indian meat and emphasized research in the area of quality control. He suggested the Scientists to undertake research for making intervention in meat catering aspects in hotel industry of the country. Dr. Ravinder Reddy, MD, RR Feeds, Hyderabad and Dr. T. R. K. Murthy, Former OSD, NRC on Meat also graced the occasion. During the function, a Memorandum of Understanding for education, training and research was signed between ICAR – NRCM and Sri Venkateswara College of Pharmacy, Madhapur, Hyderabad.

Later, a Brain Storming Session on “Strategies for doubling farmers' income through agribusiness activities” was organized to mark the celebrations. As part of the Brain storming session presentations on business prospects in small ruminant, poultry and fish value chain, and entrepreneurship through small scale meat production and processing were delivered. Presentations were followed by discussion on approaches to double farmers' income through promoting agribusiness activities in meat sector. About 100 delegates spanning from scientists, veterinarians, entrepreneurs and academicians besides a group of twenty International delegates from MSME Institute participated in the event.

In the afternoon, an open day session for school children was arranged. School children from different Schools visited the Institute and interacted with the Scientists.



Dr R. N. Chatterjee, Director, ICAR – DPR, Chief Guest of the Inaugural function delivering lecture



Visit of school students to Institute as part of open day on the occasion of foundation day



WORKSHOPS/TRAININGS/ AWARENESS PROGRAMMES/ ORGANIZED

World Zoonoses Day celebrated

ICAR-National Research Centre on Meat, Hyderabad celebrated the World Zoonoses Day on 11th July, 2017. The theme of the celebrations was 'Towards a healthier life', in order to educate and create public awareness about the importance of zoonoses. Dr. Ashok Kumar, Assistant Director General (Animal Health), ICAR, New Delhi graced the celebrations as Chief Guest for the inaugural function. Dr. V.V. Kulkarni, Director of the Institute welcomed the delegates and briefed about the World Zoonoses Day. He also spoke about the importance of surveillance systems for combating zoonotic infections. The Guest of Honour, Dr. P. Venkateswara Reddy, Chief Veterinary Officer, Greater Hyderabad Municipal Corporation (GHMC) spoke about animal welfare activities of GHMC and underlined the importance of awareness programmes about zoonotic infections.



Entrepreneurial Training Program on 'Value Added Meat Product Processing'

Entrepreneurial training program on 'Value added meat product processing' was organized at ICAR – National Research Centre on Meat, Hyderabad from 15th to 19th December 2017. Thirteen participants participated in the program. Participants included team from RR Foods, Hyderabad. Program was inaugurated by Dr S Vaithiyanathan, Director (Acting). Hands-on training on

preparation of cut-up parts of poultry and production of value added chicken products like cured and smoked chicken, sausages, patties, nuggets, pickles, enrobed products, croquettes, retort processed meat products etc was provided. Valedictory ceremony of the Program was held on 19th December 2017. During the ceremony Dr Suresh Devatkal, Director (Incharge) distributed participation certificates to participants. Trainees expressed satisfaction over the information and skills gained during the training program. Dr Girish Patil, S., Principal Scientist, Dr. Laxman Chatlod, Scientist and Dr. Rituparna Banerjee, Scientist were the Training coordinators.



Participants of the training program on, 'Value added meat product processing' along with Scientists

Training program on 'Clean and Hygienic Chicken Production'

Training program on 'Clean and hygienic chicken production' was organized at ICAR – National Research Centre on Meat, Hyderabad on 16th January 2018. Twelve participants from Amrutha Feeds, Maharashtra and entrepreneurs from Tamil Nadu participated in the training. Dr. S. B. Barbuddhe, Principal Scientist & Training Coordinator inaugurated the training in presence of other training coordinators and Scientists of the Centre. During the training program trainees were taught on hygienic slaughter of animals, preparation of cut up parts, packaging of meat and production of different value added meat products.



Trainees interacting with Scientists



MANAGE sponsored short-course organised

National Institute of Agricultural Extension Management (MANAGE), Hyderabad sponsored 10 days short course on “Entrepreneurship Development in Meat Value Chain: A Drive for Sustainable Animal Production and Employment Generation” was organised at ICAR-National Research Centre on Meat, Hyderabad during 12th to 21st February, 2018. Smt. V. Usha Rani, IAS, Director General, MANAGE inaugurated the programme as chief-guest on 12th February 2018. Twenty six participants, mainly officials from veterinary and allied departments and ICAR-SAU's from Karnataka, Telangana, Andhra Pradesh, Kerala, Tamil Nadu, Maharashtra, Goa and Uttar Pradesh had undergone the training. Dr. Naveena, B.M., Senior Scientist was the Course Director. The training covered various aspects of meat animal and poultry production especially organic livestock production, hygienic meat production, scope for value addition and further processing, ensuring authenticity and safety in meat value chain including traceability, start-up initiatives in livestock sector, e-commerce and online retailing, employment opportunities in meat sector etc.



Hon. DG, MANAGE releasing the training manual in the inaugural program of the short course

Awareness programmes

Awareness Program on 'Business models for enhancing profitability in sheep value chain'

With the aim to promote business orientation in sheep value chain among sheep farmers of Nellore district, an awareness program on, 'Business models for enhancing profitability in sheep value chain' was organized on 27th December 2017 by ICAR – National Research Centre on Meat, Hyderabad under Agri Business Incubator project in collaboration with Department of Animal Husbandry, Nellore, Muppavarapu Foundation, Swarna Bharat trust and Mandava Foundation, Venkatachalam, Andhra Pradesh. About 65 sheep farmers from different villages of Nellore district participated in the program. Program was chaired by Mr. Koteswar Rao, Director, Swarna Bharat Trust, Venkatachalam. Dr. S. Vaithiyanathan, Director (Acting), ICAR – NRC on Meat was the chief

guest of the function. Dr. Bharat Ramesh, Joint Director, Dept of Animal Husbandry, Nellore was Guest-of-Honour of the function. In the program Dr. Girish Patil, S., Principal Scientist delivered lecture on, 'Business models for enhancing profitability in sheep value chain' and Dr. M. Muthukumar, Senior Scientist delivered lecture on, 'Importance of value addition to meat for enhancing farmers income'. Dr. Srinivasulu Naidu, VO, Mandava Foundation, Dr. Koteswar Rao, AD (ISDP) and Dr. Jayachandran, AD (AH) were also present on the occasion



Dr Bharat Ramesh, Joint Director (AH), Nellore addressing the gathering in the program

Farmers First Programme

NRC on Meat has been associated with the 'Farmers First' programme of Indian Institute of Millets Research (IIMR), Hyderabad. Women self help groups (SHGs) were selected in Nyalkal and Raikode mandals of Sanga Reddy district.

Awareness programmes were conducted on scientific sheep and goat farming and health care. Sheep and goats were distributed to self-help groups of women farmers and tribal women on 4 September, 2017.



Awareness programme for butchers

An awareness programme for butchers was organized at Bhongir municipal commissioner's office, Bhongir on hygienic meat production on 28 March, 2018.



Participation in Exhibitions

Exhibition stall at Medaram Jatra

With the aim to promote clean meat production and value addition technologies among stakeholders a stall was installed at Sammakka and Sarakka Jatra at Medaram, Jaishankar Bhoopalpally district, Telangana from 27th to 30th January 2018. District administration provided necessary space and facilities for the stall. Posters were displayed, brochures were distributed and products were marketed in the stall. Several visitors including Mr. Madhusudhan Chary, Speaker, Telangana Assembly and Mr. Karnan, Collector visited the stall and interacted regarding the technologies offered by NRC on Meat.



Interaction of Mr. Madhusudhan Chary, Speaker, Telangana State Assembly and Mr. Karnan, Collector with NRCM staff members



Awareness creation on clean meat production and value addition at Medaram Jatra



Participation in Krishi Unnati Mela

ICAR – NRC on Meat, Hyderabad participated in the Krishi Unnati Mela organized at ICAR-IARI, New Delhi during 16-18 March, 2018. Over 5000 farmers/visitors visited the exhibition stall of the Institute



ICAR – NRC on Meat participated in Festival of Innovation and Entrepreneurship 2018 at Rashtrapati Bhawan

ICAR – NRC on Meat, Hyderabad participated in the Festival of Innovation and Entrepreneurship 2018 organized at Sports Ground, Rashtrapati Bhavan, New Delhi from 19th to 23rd March 2018. Program was organized by National Innovation Foundation-India. Exhibition was inaugurated by Shri Ram Nath Kovind, Hon'ble President of India on 19th March 2018. Progressive start-up entrepreneurs Mrs. K Sulochana and Mr. K. Anjaneyulu, Rukshita Pork Pvt. Ltd, Mahabubnagar who have been supported technically by ICAR – National Research Centre on Meat, Hyderabad put up a stall in the event to give overview of activities. Dr. M. Muthukumar, Senior Scientist & PI, ABI also participated in the event.



**Dr M. Muthukumar, Mr K. Anjaneyulu & Mrs. K. Sulochana,
at Festival of Innovation and Entrepreneurship 2018**

DISTINGUISHED VISITORS

Dr. Trilochan Mohapatra, Secretary (DARE) & DG (ICAR) visited the Centre on 14th May, 2017 for laying the Foundation stone of Auditorium.



Dr. Joykrushna Jena, DDG (Animal Science) visited the Centre on 14th May, 2017 and interacted with all the staff.

Honourable MLA, Uppal Constituency, Shri NVSS Prabhakar visited NRC on Meat on 29th May, 2017.





Dr. Ashok Kumar, ADG (Animal Health) visited the Centre on 11th July, 2017



Dr. M. Srinivas Reddy, Honorable MLC, Govt of Telangana visited NRC on Meat on 12th December, 2017.

Shri Suresh Chanda (IAS), Special Chief Secretary, Dept of Animal Husbandry, Fisheries and Dairy, Govt. of Telangana visited NRC on Meat on 20th December, 2017.

Mrs. V. Usha Rani, Director General, MANAGE, Rajendra nagar, Hyderabad visited the Centre on 12th February, 2018.



PERSONNEL

Scientific		
1	Dr. V. V. Kulkarni	Director (upto 28-09-2017)
2	Dr. S. Vaithyanathan	Acting Director (from 29-09-2017)
3	Dr. S. B. Barbuddhe	Principal Scientist
4	Dr. Suresh Devatkal	Principal Scientist
5	Dr. Girish Patil	Principal Scientist
6	Dr. C. Ramakrishna	Senior Scientist
7	Dr. B.M. Naveena	Senior Scientist
8	Dr. M. Muthukumar	Senior Scientist
9	Dr. P. Baswa Reddy	Senior Scientist
10	Dr. Kandeepan	Scientist (Sr. Scale)
11	Dr. L. R. Chatlod	Scientist
12	Dr. S. Kalpana	Scientist
13	Mrs. K. Varalakshmi	Scientist
14	Dr. Rituparna Bannerjee	Scientist
15	Dr. Vishnuraj, M.R.	Scientist
Administrative		
1	Mr. Chandrasekhar	Administrative Officer (Up to 30th June, 2017)
2	Mr. B.P.R. Vithal	Private Secretary (PS) to Director
3	Mr. Mariseti N.V.Rao	Assistant Finance and Accounts Officer
4	Mrs. C. Padmaja	Personal Assistant (PA) to Director
5	Mr. Shaik Rukman	Junior Accounts Officer
6	Mr. T. Devender	Assistant
7	Miss Kola Alekhya	Assistant
8	Mr. Sri Harsha	Assistant
9	Mrs. V. Kalpana	Upper Division Clerk



Technical		
1	Ms. Kanchana Kommi	Technical Assistant (T-3) Lab
2	Mr. P. Phani Kumar	Technical Assistant (T-3) Lab
3	Mr. B.V.D. Srinivasa Rao	Technician (T-2) Draftsman
4	Mr. Mandala Srinivas	Technician (T-2) Cook

New Appointments

Kum. Kola Alekhya, Assistant (DR) has joined the Centre on 28.07.2017

Shri. Sri Harsha Jammula, Assistant (DR) has Joined the Centre on 13.12.2017.

Joining

Dr. S.B. Barbuddhe, Principal Scientist joined the Centre consequent upon his transfer from NIBSM, Raipur on 01.06.2017.

Dr. Girish. S. Patil, Principal Scientist joined the Centre consequent upon his transfer from National Research Centre on Pig, Rani, Guwahati, Assam on 15.06.2017

Superannuation

Shri Chandrasekhar, Administrative Officer superannuated from ICAR-NRCM on 30.06.2017

Transfers

Dr. Smruthirekha Mallick, Scientist has been transferred to DFMD, Mukteshwar and was relieved from the duties of this Centre on 31.05.2017

Dr. V.V. Kulkarni, Director was relieved from the services of the Institute consequent upon completion of his tenure as Director on 28.09.2017

Committees

Quinquennial Review Team

1. Dr. J. Abraham, Consultant Meat Technologist, “Sharon”, Santosh Nagar, Mannuthy, Thrissur, Kerala - Chairman
2. Dr. Sarfaraz Wani, Dean, Veterinary College, SKUAST Kashmir, Shuhuma Campus, Srinagar - Member
3. Dr. K. N. Selvakumar, Dean, Veterinary College and Research Institute, Orathanadu, Thanjavur, Tamil Nadu - Member
4. Dr. K. C. Varshney, Head, Department of Veterinary Pathology Rajiv Gandhi Institute of Veterinary Education & Research, Kurumbapet, Puducherry- Member
5. Dr. Chetan Kumar Thota, Director (International Business) Allansons Ltd, Surya Towers, Block-F,5th Floor, 105 Sardar Patel Road, Secunderabad- Member
6. Dr. Manish Kumar Chatli, Head Division of LPT GADVASU, Ludhiana- Member
7. Dr. S. Vaithiyanathan, Principal Scientist, ICAR-NRC on Meat, Hyderabad - Member - Secretary

Research Advisory Committee

1. Dr. J.K.Malik, Former Joint Director, IVRI, Izatnagar - Chairman
2. Dr. U. K. Pal, Professor & Head, Dept. of LPT, Rajiv Gandhi Institute of Veterinary Education & Research, Kurumbapet, Puducherry - Member
3. Dr. Mineswar Hazarika, Professor & Head, Division of LPT, Faculty of Veterinary Science , AAU, Khanapara Campus, Guwahati - Member
4. Dr. George T. Oommen, Former Professor & Head, Division of LPT, College of Veterinary & Animal Sciences, Pookot, Kerala - Member
5. Dr. S. Vaithiyanathan, Director (Acting) ICAR-NRC on Meat, Hyderabad - Member
6. Dr. B.S. Prakash, Asst. Director General (AN&P), Indian Council of Agricultural Research, KrishiBhavan, New Delhi – 110 001 - Member
7. Dr. S. B. Barbuddhe, Principal Scientist, ICAR-NRC on Meat, Hyderabad - Member Secretary

Institute Management Committee (IMC)

1. Dr. S.Vaithiyanathan, Acting Director, National Research Centre on Meat, Hyderabad-Chairman
2. Director, Animal Husbandry Department, Govt. of Telengana State, Shantinagar, Hyderabad. - Member
3. Director, Animal Husbandry Department, Govt. of Andhra Pradesh.- Member



4. Dr. K. Kondala Reddy, Associate Dean, Sri P.V. Narasimha Rao Telengana State University for Veterinary Animal Fishery Sciences, Rajendranagar, Hyderabad-500030- Member
5. Dr. S.V. Rama Rao, Principal Scientist, ICAR – Directorate of Poultry Research, Rajendranagar - Member
6. Dr. Subeer S. Majumdar, Director, National Institute of Animal Biotechnology (NIAB), Miyapur, Hyderabad - Member
7. Dr. Ganesh Kumar, Principal Scientist, ICAR – NAARM, Rajendra Nagar, Hyderabad – Member
8. Dr. Ravishankar C.N., Director, ICAR – CIFT, Cochin - Member
9. Dr. B.S. Prakash, Asst. Director General (AN & P), Indian Council of Agricultural Research, Krishi Bhavan, New Delhi - Member
10. The Controller, ICAR – NAARM, Rajendra Nagar, Hyderabad- Member
11. Assistant Administrative Officer, National Research Centre on Meat, Chengicherla, Hyderabad – Member Secretary

Institute Animal Ethics Committee

1. Dr. S. Vaithyanathan, Acting Director, ICAR –NRC on Meat, Hyderabad – Chairman
2. Dr. B. Dinesh Kumar, Assistant Director, Food and Drug Toxicology Research Centre, National Institute of Nutrition, Hyderabad - Main Nominee
3. Dr. P. Uday Kumar, Deputy Director, National Institute of Nutrition, Hyderabad - Scientist from outside the Institute
4. Dr. Ramakrishna Sistla, Scientist, Pharmacology Division, Indian Institute of Chemical Technology, Hyderabad - Link Nominee
5. Shri G. Manjunath, International Animal and Birds Welfare Society, Gudur, Ananthapur Dist. Andhra Pradesh- Socially aware Nominee
6. Dr. C. Ramakrishna, Senior Scientist, ICAR–NRC on Meat, Hyderabad -Veterinarian
7. Dr. L.R. Chatlod, Scientist, ICAR–NRC on Meat, Hyderabad - Scientist from different discipline
8. Dr. M. Muthukumar, Senior Scientist, ICAR–NRC on Meat, Hyderabad -Scientist from different discipline
9. Dr. P. Baswa Reddy - Scientist In-Charge cum Member Secretary, Senior Scientist, ICAR –NRC on Meat, Hyderabad.

STUDENTS' CORNER

S. No	Name of the student	Research Project Topic	Members of Advisory Committee
1	Dr. Sahana M. M.V. Sc. Student, College of Veterinary Science, Bengaluru	Detection of pork fat and lard using polymerase chain reaction (PCR)	Dr. S. Vaithiyanathan, Principal Scientist Dr. M. Muthukumar, Senior Scientist
2	Dr. Dhanashree Didolkar, M.V.Sc student, Dept. of LPT, Mumbai Veterinary College, Mumbai	Development of intelligent packaging indicator for monitoring chicken meat quality during refrigeration storage	Dr. Kandeepan. G., Scientist (Sr. Scale)
3	Dr. V. S. Priyanka Dept. of LPT, College of Veterinary Sciences, Bengaluru	Quality attributes and shelf life evaluation of retort processed cereal based chicken stew	Dr. M. Muthukumar, Senior Scientist Dr. B. M. Naveena, Senior Scientist
4	Dr. K. B. Namratha M.V.Sc Student, College of Veterinary Sciences, Bengaluru	Effect of low voltage electrical stimulation on the quality and proteome changes in sheep meat	Dr. B. M. Naveena, Senior Scientist



राजभाषा कार्यान्वयन

आईसीएआर— राष्ट्रीय मांस अनुसंधान केंद्र, हैदराबाद के कर्मचारियों ने हिंदी प्राज्ञ और पारंगत परीक्षा उत्तीर्ण की है और कर्मचारियों को 29 अप्रैल, 2017 को संस्थान में आयोजित एक दिवसीय कार्यशाला पर प्रमाण पत्र वितरित किए गए थे।



राष्ट्रीय मांस अनुसंधान केंद्र, हैदराबाद में 11 से 14 सितंबर, 2017 तक 'हिंदी सप्ताह' मनाया गया। इस अवसर पर हिंदी में कई प्रतियोगिताओं आयोजित की गईं, सुलेख, शब्दार्थ, सामान्य ज्ञान आदि। सभी वैज्ञानिक, प्रशासनिक और तकनीकी कर्मचारियों ने इन सभी प्रतियोगिताओं में स्वेच्छा से भाग लिया। वैदिक सत्र 14 सितंबर को आयोजित किया गया था और राष्ट्रीय पोषण संस्थान, हैदराबाद के तकनीकी अधिकारी श्री अनिल कुमार दुबे ने इस अवसर को मुख्य अतिथि के रूप में सम्मानित किया। सभी विजेताओं को नकद पुरस्कार से सम्मानित किया गया था।

आईसीएआर— राष्ट्रीय मांस अनुसंधान केंद्र, हैदराबाद ने राजभाषा कार्यान्वयन के लिए सर्वश्रेष्ठ प्रदर्शन की मान्यता में तृतीय पुरस्कार प्राप्त किया। यह पुरस्कार 21 सितंबर, 2018 को राष्ट्रीय ग्रामीण विकास और पंचायत राज संस्थान, हैदराबाद में आयोजित नगर भाषा कार्यान्वयन समिति -2 की बैठक में प्रदान किया गया।



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SWACHHTA MISSION



NRCM staff taking Swachhta Pledge



Swachhta Pakhwada was celebrated at National Research Centre on Meat, Hyderabad from 16th to 31st May, 2017 with great enthusiasm and all the staff members actively participated in the Swachhta Mission. The program began with Dr. S. Vaithyanathan, administering the “Swachhta Shapath” at 11:00 AM. All the Scientific, technical, administrative and contractual staff took pledge.

Several programs were conducted during this period:-

To commemorate Swachhta Pakhwada celebrations Dr. T.N. Raju, retired Professor, Osmania University, Hyderabad was invited to address the staff about “Biology of Cataract” on 18th May, 2017.

As a part of Swachhta Pakhwada celebrations a lecture on “Ethno veterinary Medicine” was delivered by Dr. N. Punniyamurthy, retired professor & Head, TANUVAS, Chennai on 19th May, 2017.

Swachh Bharat Abhiyan was performed as part of Swachhta Pakhwada. All the staff- scientific, administrative, technical and contractual members of NRC on Meat actively participated. Laboratories, stores and office premises were cleaned on 20th May, 2017.

Two number of rainwater harvesting pits were constructed to increase the groundwater level in the campus.

Scientists of the Centre visited the Municipal Solid waste management plant operated by RAMKY situated at Jawahar Nagar, Hyderabad on 24th May, 2017.

To commemorate the Swachhta Pakhwada celebrations an awareness procession was taken out from NRC on Meat gate to Chengicherla village. Many placards-slogans/quotes and banner about Swachh Bharat were carried by the staff. The procession traversed many streets of the village and all along the roads were swept and trash was collected simultaneously.



Honorable Member of Legislative Assembly, Uppal constituency, Shri NVSS Prabhakar was invited to NRC on Meat on 29th May, 2017. Hon. MLA participated in Swachh Bharat Abhiyan and planted a sapling of flowering tree in campus. Subsequently, he interacted with the NRCM staff



Shri NVSS Prabhakar, M.L.A. planted a tree

A concluding session of Swachhta Pakhwada was conducted on 31st May, 2017. All the staff – members attended the session. Activity schedule of Swachhta Pakhwada was presented by Swachh Bharat Abhiyan Nodal Officer. Director addressed the staff and briefed about the importance of Swachh Bharat Abhiyan. Videos on different aspects of Swachh Bharat Abhiyan were shown to the staff.

“Swachhta Hi Seva” campaign at NRC on Meat

“Swachhta Hi Seva” campaign was celebrated at National Research Center on Meat, Hyderabad from 15th September, 2017 with great enthusiasm and all the staff members actively participated in the campaign. The program began with Dr. V. V. Kulkarni, Director, NRC on Meat, administering the Swachhta shapath. All the scientific, technical, administrative and contractual staff took pledge.

“Swachhta Hi Seva” banners were displayed at appropriate places in and outside the campus. Every day Shramdaan was performed by all the staff of the Centre throughout the campaign period.

Celebration of Sewa Diwas

Sewa Diwas was celebrated at the Center on 17th September, 2017. All the staff of institute actively participated in the Sewa Divas by devoting 2 hours in the dedicated cleaning and sweeping of the campus.



Celebration of Samagra Swachhta Diwas

National Research Center on Meat, Hyderabad celebrated Samagra Swachhta Diwas on 24th September, 2017 as a part of Swachhta Hi Seva campaign. All the employees of the Centre participated in the program with great enthusiasm and performed shramdaan for two hours.



Plantation of trees

As a part of Swachhta Hi Seva campaign plantation of trees was done on 23rd September, 2017 at National Research Center on Meat, Hyderabad







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