



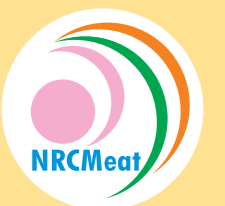
# वार्षिक प्रतिवेदन ANNUAL REPORT 2014-2015



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**ICAR-National Research Centre on Meat**  
Chengicherla, Boduppal, Hyderabad - 500092  
An ISO 9001 : 2008 Certified Organization



# ANNUAL REPORT

## 2014-15



**ICAR - NATIONAL RESEARCH CENTRE ON MEAT**

**Chengicherla, Boduppal, Hyderabad - 500092**

*An ISO 9001:2008 Certified Organization*





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## PREFACE

Food processing sector in India is one of the fastest growing sector of the economy with the growth rate of 8.4%. India has the potential to become a global leader in food processing sector and can close the gap between farmers and consumers. Livestock sector which includes dairy, poultry and meat is an important component to ensure food security and nutrition. India has been witnessing impressive growth in meat production with an annual production of 6.29 million tonnes during the year 2012. According to USDA, global beef exports are poised to reach a record 10.2 million tonnes in 2015 mainly due to largest shipment from India which is projected to export 2.4 MT in 2015 against Brazil's 2.0 MT.

With its mission to develop modern, organised meat sector through meat production, processing and utilization technologies, the ICAR-National Research Centre on Meat, Hyderabad has been striving through various innovative approaches. In the year 2014-15, the Institute has mainly contributed in the field of meat science research, trainings, workshops, exhibitions, awareness, entrepreneurship development programs, MoU/Agreements with private entrepreneurs, consultancy and organising a National workshop. I take this opportunity to present an overview of important activities for the period from April, 2014 to March, 2015.

In the research front, the NRC on Meat is undertaking need based projects related to designer meat production through nutritional intervention and processing strategies, organic meat production, prevalence of sarcocystis in different parts of the country, studying the nationwide yield of meat and byproducts, proteomics of lipid oxidation induced oxidation, experiments on emu meat storage, processing and value addition, proteomic and DNA based technologies for detection of adulteration of meat and animal fats, estimation of chemical residues in chicken and fish samples, development of ready-to-eat and value added meat products and other preservation techniques and microbial quality of meat and meat products. The Institute is handling external funded projects from Department of Science and Technology (DST), Ministry of Statistics and Program Implementation (MoSPI), Department of Biotechnology (DBT), Agricultural and Processed Food Products Export Development Authority (APEDA), Government of India, and Directorate of Animal Husbandry, Government of Telangana under RKVY scheme. Two new projects viz. assessing the impact of buffalo slaughter and meat export on livestock population (funded by APEDA) and ICAR Lal Bahadur Shastri Award Project on mapping skeletal muscle proteins from different buffalo breeds of India have been initiated. Besides these, Institute is also undertaking contract research with private multinational companies viz., Kancor Ingredients Pvt. Ltd, Kerala, PrARAS Biosciences, Bangalore and EESAVYASA Technologies Pvt. Ltd., Hyderabad. The Institute has also done a collaborative project with Krishna Emu Products Ltd., Vijayawada.



The Institute is receiving several meat/fat samples for species identification from export meat plants, Forest and Animal Husbandry Departments of different states. Meat samples were also received for quality and shelf-life analysis from different meat processors and institutions.

In addition to good number of need based research projects, one National workshop on traceability, two entrepreneurship training programs, one NEH stakeholders meeting, one training program to Veterinary officers from AH Department and three awareness programmes were organised. The Institute also showcased its technologies at Poultry India-2014, Hyderabad and Meat Tech Asia-2014, Bangalore. The Centre also signed MoUs for providing consultancy to establish slaughterhouse and rendering plant. During the current year, the Institute licensed the Technical Know-How on preparation of value added meat products. I am very glad to mention that during this year, the Institute has been awarded with ISO 9001:2008 certificate for quality management system. I am elated to mention that one of the scientist of this Centre has been awarded with prestigious Lal-Bahadur Shastri young scientist award for the year 2013 and AAO of this Centre was elected as Secretary (SS), CJSC, ICAR. The Centre has achieved one more milestone by launching “Meat on Wheels” for promotion and popularisation of value added meat products during the World Food day celebration on 16<sup>th</sup> October, 2014. The Centre celebrated ICAR foundation day by organising a “Consumer awareness on importance of meat and its health benefits”. The Centre conducted 9<sup>th</sup> Institute Research Council (IRC) and 7<sup>th</sup> Research Advisory Committee (RAC) meetings for the year 2014. Besides these, the Institute has undertaken several “Swachh Bharat Abhiyan” and campus cleaning programmes. During the period, several dignitaries including Dr. Suresh S. Honnappagol, Animal Husbandry Commissioner, Dept. of AH, Dairying and Fisheries, Govt. of India and students and faculty members from Cornell University, USA visited NRC on Meat.

I am sure, we will continue to see sustained and also rapid growth in our work, by venturing into newer and unexplored areas of research. The encouragement, suggestions and ideas from Honourable Dr. S. Ayyappan, Secretary (DARE) & DG, ICAR, Dr. K.M.L. Pathak, DDG (Animal Sciences), Dr. B.S. Prakash, ADG (AN&P), Dr. Vineet Bhasin & Dr. Rajan Gupta, Principal Scientists, members of IMC, RAC and other experts of meat science community are most welcome and we gratefully acknowledge them. I also thank all the scientists and other staff of NRC Meat in their effort to bring out his report which will provide significant information to the readers.

**(V.V. Kulkarni)**  
**Director**

## प्रस्तावना

भारत में खाद्य प्रसंस्करण क्षेत्र 8.4: विकास दर के साथ अर्थव्यवस्था का तेजी से विकसित होने वाला क्षेत्र है। खाद्य प्रसंस्करण क्षेत्र में भारत में विश्व का नेतृत्व करने की क्षमता है और वह किसानों तथा उपभोक्ताओं के बीच अंतराल को कम कर सकता है। पशुधन क्षेत्र, जिसमें दूध, मुर्गीपालन व मांस शामिल हैं, खाद्य सुरक्षा व पोषण सुनिश्चित करने, हेतु एक महत्वपूर्ण घटक है। वर्ष 2012 के दौरान 6.29 मिलियन टन के वार्षिक उत्पादन के साथ भारत मांस उत्पाद के क्षेत्र में प्रभावशाली विकास कर रहा है। यूएसडीए के अनुसार 2015 में ब्राजील के 2.0 मेट्रीक टन निर्यात की तुलना में प्रमुखतः भारत के 2.4 मेट्रीक टन के निर्यात के लक्ष्य के कारण वैश्विक मांस निर्यात 2015 में रिकार्ड 10.2 मिलियन टन पहुंचने की संभावना है।

मांस उत्पादन, प्रसंस्करण और उपयोगिता तकनीक के जरिए आधुनिक, संगठित मांस क्षेत्र विकसित करने के अपने लक्ष्य में आईसीएआर-राष्ट्रीय मांस अनुसंधान केंद्र, हैदराबाद विभिन्न अनुसंधानों के माध्यम से निरंतर प्रयास कर रहा है। वर्ष 2014-15 में इस संस्था ने मांस विज्ञान अनुसंधान, प्रशिक्षण, कार्यशाला, प्रदर्शनी, जागरूकता, उद्यमिता विकास कार्यक्रमों, निजी उद्यमियों के साथ समझौता ज्ञापन करार और एक राष्ट्रीय कार्यशाला आयोजित करते हुए इस क्षेत्र में प्रमुख योगदान दिया है। मैं इस अवसर पर अप्रैल, 2014 से मार्च 2015 के दौरान इस केंद्र की अवधि में महत्वपूर्ण गतिविधियों का संक्षिप्त विवरण प्रस्तुत कर रहा हूं।

अनुसंधान के क्षेत्र में राष्ट्रीय मांस अनुसंधान केंद्र पोषण-संबंधी हस्तक्षेप और प्रसंस्करण रणनीति के जरिए डीजाइनर मांस उत्पाद से संबंधित आवश्यकता आधारित परियोजनाओं का काम, ऑर्गनिक मांस उत्पादन, भारत के विभिन्न हिस्सों में सार्कोसिस्ट की प्रधानता, मांस और उपोत्पादों के राष्ट्रीय पैदावार का अध्ययन, लिपिड ऑक्सीकरण व प्रेरित ऑक्सीकरण का प्रोटियोमिक्स, एमु मांस भंडारण पर प्रयोग, प्रसंस्करण और मूल्य संवर्धन, मांस और पशु वसा के मिलावट का पता लगाने के लिए प्रोटियोमिक और डीएनए आधारित प्रौद्योगिकी, मुर्गी और मछली के नमूनों में रासायनिक अवशेषों का प्राक्कलन, खाने के लिए तैयार और मूल्य संवर्धित मांस उत्पादों और अन्य परिरक्षण तकनीकियों का विकास तथा मांस और मांस उत्पादों की सूक्ष्मजीव गुणवत्ता आदि पर काम कर रहा है। यह संस्थान विज्ञान और तकनीकी विभाग (डीएसटी), सांख्यिकी और कार्यक्रम कार्यान्वयन मंत्रालय (एम.ओ.एस.पी), जैव तकनीकी विभाग, कृषि और प्रसंस्करण खाद्य उत्पाद निर्यात विकास प्राधिकरण (ए.पी.ई.डी.ए), भारत सरकार और आरकेवीवाय योजना के अंतर्गत पशुपालन निदेशालय, तेलंगाना सरकार की बाह्य निधि परियोजनाओं पर भी कार्य कर रहा है। दो नई परियोजनाएं अर्थात् पशुधन जनसंख्या पर भैंस संहार और मांस उत्पादन (अपेडा द्वारा निधि प्रदत्त) और भारत के विभिन्न नस्लों की भैंसों से कंकाल मांसपेशी प्रोटीन का पता लगाने के लिए आईसीएआर द्वारा लाल बहादुर शास्त्री पुरस्कार परियोजना आरंभ की गई है। इसके अतिरिक्त इस संस्था ने कैनकोर इनग्रेडियंट प्रा.लि. केरल, PrARAS बायोसाइंन्स, बेंगलोर और ईसावैश्या टेक्नालॉजी प्रा.लि. हैदराबाद जैसे निजी बहुराष्ट्रीय कंपनियों के साथ अनुबंध अनुसंधान का कार्य भी आरंभ किया है। इस संस्थान ने कृष्णा एमु प्रोडेक्ट लि., विजयवाड़ा के साथ सहयोगपूर्ण परियोजना भी आरंभ की है। इस संस्थान में विभिन्न राज्यों के निर्यात मांस संयंत्र, वन और



पशुपालन विभाग से प्रजाति पहचान के लिए कई मांस के नमूने प्राप्त हो रहे हैं। विभिन्न मांस संसाधक और संस्थानों से गुणवत्ता और सामग्री के भंडार और उपयोग होने तक की अवधि के लिए नमूने भी प्राप्त हो रहे हैं।

आवश्यकता पर आधारित अनुसंधान की कई परियोजनाओं के अतिरिक्त, पता लगाने की योग्यता पर एक राष्ट्रीय कार्यशाला, दो उद्यमिता प्रशिक्षण कार्यक्रम, एक एनईएच भागीदारी बैठक, एक पशुपालन विभाग के पशुचिकित्सक अधिकारियों के लिए प्रशिक्षण कार्यक्रम, तीन जागरुकता कार्यक्रम आयोजित किए गए। इस संस्थान ने मुर्गीपालन भारत-2014, हैदराबाद और मांस प्रौद्योगिकी एशिया 2014 के दौरान, बंगलोर में अपनी प्रौद्योगिकी का प्रदर्शन भी किया है। इस केंद्र ने बूचड़खाना और प्रतिपादन संयंत्र की स्थापना में परामर्श देने के हेतु एक समझौता ज्ञापन पर हस्ताक्षर किया है। इस वर्ष के दौरान, इस संस्थान ने मूल्य वर्धित मांस उत्पाद की तैयारी पर तकनीकी जानकारी का लाइसेंस जारी किया है। मुझे यह उल्लेख करते हुए अत्यंत हर्ष हो रहा है कि इस वर्ष के दौरान इस संस्थान को गुणवत्ता प्रबंधन प्रणाली के लिए आईएसओ 9001:2008 प्रमाणपत्र से सम्मानित किया गया है। मुझे यह कहते हुए गर्व का अनुभव हो रहा है कि इस केंद्र के एक वैज्ञानिक को प्रतिष्ठित लाल बहादुर शास्त्री युवा वैज्ञानिक पुरस्कार 2013 से सम्मानित किया गया है। हमारे ही केंद्र के एक सं.प्र. अधिकारी को सचिव (एसएस), सीजेएससी, आईसीएआर के रूप में चुना गया है। इस केंद्र ने 16 अक्टूबर, 2014 को विश्व खाद्य दिवस समारोह के अवसर पर मूल्य वर्धित मांस उत्पादों के उन्नयन और लोकप्रियता के लिए पहियों पर मांस आरंभ करके एक और मील के पत्थर को पार किया है। इस केंद्र ने "मांस का महत्व और उसके स्वास्थ्य वर्धक लाभ" का आयोजन करके अपना आईसीएआर स्थापना दिवस मनाया। इस केंद्र ने वर्ष 2014 के लिए 9 वां संस्थान अनुसंधान परिषद और 7 वां अनुसंधान सलाहकार समिति (आरएसी) की बैठक आयोजित कर ली है। इसके अतिरिक्त संस्था ने "स्वच्छ भारत अभियान" चलाने के साथ-साथ परिसर की सफाई कार्यक्रम का भी आयोजन किया है। इस अवधि के दौरान डॉ. सुरेश एस होन्नप्पागोल, पशुपालन आयुक्त, पशुपालन विभाग, दूध और मछली पालन, भारत सरकार ने इस केंद्र का दौरा किया, साथ ही कोर्नल विश्वविद्यालय, यूएसए के संकाय सदस्यों ने भी एनआरसीएम का दौरा किया।

मुझे विश्वास है कि हम अपने कार्यों में अनुसंधान के नए और अनछुए क्षेत्रों में प्रवेश करके निरंतर और तेजी से विकास की ओर अग्रसर होंगे। हम माननीय डॉ. एस. अय्यप्पन, सचिव, डीएआरई, व डीजी, आईसीएआर, डॉ. के.एम.एल. पाठक, डीडीजी (पशुपालन विज्ञान), डॉ. बी.एस. प्रकाश, एडीजी (एनएंडपी), डॉ. विनीत भसीन, डॉ. राजन गुप्ता, प्रमुख वैज्ञानिक, आईएमसी के सदस्य, आरएसी और मांस विज्ञान समुदाय के अन्य विशेषज्ञों के प्रोत्साहन, सलाह और सुझावों का हार्दिक स्वागत करते हैं और इसके लिए हम उनके आभारी हैं। मैं पाठकों को विशिष्ट सूचना देने वाली इस रिपोर्ट के प्रकाशन से जुड़े एनआरसीएम के सभी वैज्ञानिकों और अन्य कर्मचारियों को उनके प्रयासों के लिए धन्यवाद देता हूँ।



(वी.वी. कुलकर्णी)  
निदेशक

## EXECUTIVE SUMMARY

ICAR-National Research Centre on Meat (NRCM), Hyderabad was established with an overall objective to conduct basic and applied research, to promote quality meat production, value addition, training, consultancy, contract research projects and entrepreneurship development and to provide policy support to line departments. The Institute is catering to the needs of large group of meat animal producers, meat processors, exporters, butchers, entrepreneurs and consumers and is working towards developing organized meat sector in India. The summary of the Institutes activities during the period from April 2014 to March 2015 is presented below:

- ◆ Feeding concentrate feed at the rate of more than 1% of body weight to deccan ram lambs has increased the fat percentage of the carcasses and decreased the omega-3 fatty acids as % of total fatty acids.
- ◆ The Centre has obtained organic fodder certification under the project organic mutton production.
- ◆ The CSO sponsored study revealed that 40% of the sheep slaughtered in India (selected from 5 states) were in the weight group of > 15 to < 20 kg, whereas, 37% of the goats slaughtered were in the weight group of > 15 to < 20kg. The 48% of chicken birds slaughtered were in the weight group of below 1.5 kg.
- ◆ Proteomics of buffalo and goat meat studies revealed the greater ( $P < 0.05$ ) thermostability of buffalo myoglobin (Mb) relative to goat Mb at typical meat cooking conditions. Buffalo Mb is more ( $P < 0.05$ ) stable compared to goat Mb in presence of oxidizing lipids.
- ◆ Proteomic based approach using the OFFGEL electrophoresis procedure was standardized and the myosin light chain-3 (MLC-3) was separated from other proteins and further confirmed using SDS-PAGE.
- ◆ 2-dimensional electrophoresis based approach for separating MLC-1, 2 & 3 from buffalo, sheep and goat meat was also standardized.
- ◆ Technologies were developed for the production of value added emu meat products viz, sous-vide sausages and enrobed emu meat nuggets.
- ◆ Chicken meat products enriched with omega-3 fatty acids prepared.
- ◆ Raw meat samples (chicken, mutton, beef & pork) collected from retail meat vendors and processed for isolation of *E.coli*.
- ◆ Out of a total of 1,236 oesophagus and 354 muscle/meat samples examined from slaughtered buffaloes at Hyderabad, Mumbai and Delhi, 462 oesophagus (37.38%) and 26 meat (7.35%) samples were found positive for Sarcocystosis.



- ◆ An open access Livestock traceability database ([www.livestocktraceindia.com](http://www.livestocktraceindia.com)) was established and traceability system developed by the Centre was pilot tested in different buffalo farms and export abattoir.
- ◆ Solid phase extraction and optimization of methods using HPLC was completed for analysis of selected antibiotics in meat and fish products.
- ◆ Different natural antimicrobial combinations were optimized to extend the colour and shelf-life of buffalo meat.
- ◆ A method was standardized to isolate DNA from animal fat and milk fat for PCR assay for species identification and to detect the adulteration upto 15%. Commercial samples were analyzed for meat/fat species identification.
- ◆ The contract research project with Kancor Ingredients Ltd., Kerala demonstrated the protective effect of Oxikan<sup>®</sup> (2.8% carnosic acid and 0.55% carnosol) at different dosage levels against lipid oxidation in raw and cooked pork and chicken patties during storage at refrigeration under aerobic packaging conditions. Oxikan<sup>®</sup> is also effective in protecting the color and exhibited significant antimicrobial activity.
- ◆ In another contract research project with PrARAS Biosciences Pvt Ltd, Bangalore, low cost chicken product incorporated with modified soy protein was developed.
- ◆ The VISION-2050 document for ICAR-NRC on Meat was finalized.

#### **Entrepreneurship training, consultancy, MoU, workshops and extension activities:**

- ◆ A workshop on sexual harassment at work place was organised on 6<sup>th</sup> May, 2014.
- ◆ Final review meeting of the Ministry of Statistics and Program Implementation (MoSPI) funded research project was organised on 10<sup>th</sup> May, 2014.
- ◆ A training program to seven Veterinarians from Dept. of Animal Husbandry, Andhra Pradesh on “Management of modern abattoir” was organised from 19<sup>th</sup> to 21<sup>st</sup> May, 2014.
- ◆ A National workshop on “Implementation of livestock/meat traceability in India” was organized on 4<sup>th</sup> August, 2014 in collaboration with Indian Meat Science Association, Hyderabad.
- ◆ Interactive meeting with stakeholders on “Status and requirements of meat sector in NEH states” was organised in collaboration with NRC on Pig, Guwahati on 19<sup>th</sup> August, 2014 and in collaboration with ICAR Research Complex, Barapani on 18<sup>th</sup> September, 2014.
- ◆ Two hands-on entrepreneurial training programs on “Value added chicken products processing, packaging” was organised for small and medium scale entrepreneurs.

- ◆ "Meat on Wheels" was launched on 16<sup>th</sup> October, 2014 and several awareness programs were carried out on value added meat products.
- ◆ The Centre has successfully completed two contract research projects with the private companies and submitted the final reports.
- ◆ Two memorandum of understanding (MoU)/agreements were signed with entrepreneurs for licensing and test marketing of NRC Meat developed value added products.
- ◆ MoU has been signed with M/S Laxmi Engineering Works, Chennai and M/S Veteran Laboratories, Bangalore seeking consultancy.
- ◆ Showcased NRC Meat technologies at Poultry India-2014, Hyderabad and Meat Tech Asia-2014, Bangalore.
- ◆ Acted as knowledge partner with Tamil Nadu Technology Development and Promotion Centre (TNDPC) of Confederation of Indian Industry (CII) for organising Meat Tech-2014.
- ◆ Developed liaison/ collaborations and interacted with stake holders and experts from Food Safety and Standards Authority of India (FSSAI), Animal Husbandry Dept., Export meat industries, Poultry and meat processors, University officials, Private entrepreneurs etc.
- ◆ Series of Swachh Bharat Abhiyan programmes were conducted both inside the campus and the neighbouring village.
- ◆ Landscaping activities were undertaken, new water fountain and drip irrigation facilities were created.
- ◆ Furnishing of new meat processing unit and guest house was undertaken for the benefit of entrepreneurs and trainees.
- ◆ The Institute celebrated ICAR foundation day, World Food day, Hindi saptah, Independence day, Republic day and conducted several campus cleaning and greening programmes.



## कार्यकारी सारांश

आईसीएआर-राष्ट्रीय मांस अनुसंधान केंद्र (एनआरसीएम), हैदराबाद की स्थापना मूलभूत और प्रायोगिक अनुसंधान का आयोजन, मांस उत्पादन की गुणवत्ता का उन्नयन, मूल्य संवर्धन, प्रशिक्षण, सलाहकारी संस्था, अनुबंध अनुसंधान परियोजना, उद्यमी विकास करने के समग्र उद्देश्य के साथ-साथ लाइन विभाग को नीतिगत समर्थन देने के लिए की गई थी। यह संस्थान मांस पशु उत्पादकों, मांस संसाधकों, निर्यातकों, कसाइयों, उद्यमियों और उपभोक्ताओं के एक बड़े समूह की आवश्यकता को पूरा करती है। साथ ही भारत में सुनियोजित मांस क्षेत्र के विकास की दिशा में कार्यरत है। अप्रैल, 2014 से मार्च 2015 तक की अवधि के दौरान संस्था की गतिविधियों का सारांश नीचे दिया जा रहा है।

- भेड़ के बच्चे को उसके शारीरिक वजन के 1% से अधिक की दर से मुख्य भोजन खिलाने के कारण देह में वसा के प्रतिशत में वृद्धि होने के साथ-साथ ओमेगा-3 वसा अम्ल की मात्रा में भी वृद्धि हुई है।
- परियोजना जैविक मटन उत्पादन के अंतर्गत केंद्र ने जैविक चारा प्रमाणपत्र प्राप्त किया है।
- सीएसओ प्रायोजित अध्ययन से पता चला है कि भारत में वध किए गए 40% (पांच राज्यों से चुना गया है) भेड़ >15 से < 20 किग्रा के वजन समूह के थे जबकि 37% बकरियां >15 से < 20 किग्रा के वजन समूह की थी। वध की गई 48% मुर्गियों का वजन समूह 1.5 किग्रा से कम था।
- भैंस और बकरी के मांस के प्रोटीओमिक्स के अध्ययन से यह पता चला है कि मांस पकाने की विशेष परिस्थिति में बकरी के एमबी की तुलना में भैंस के मायोग्लोबिन (एमबी) का थर्मो स्थिरता अधिक (पी<0.05) होती है। ऑक्सीकरण लिपिडों की उपस्थिति में भैंस के एमबी में बकरी के एमबी की तुलना में अधिक (पी<0.05) स्थिरता होती है।
- ऑफजेल वैद्युतकणसंचलन (इलैक्ट्रोफोरेसिस) कार्यविधि का उपयोग करके प्रोटीओमिक आधारित दृष्टिकोण का मानकीकरण किया गया और मायोसिन लाइट चेन-3 (एमएलसी-3) को अन्य प्रोटीन से अलग करके एसडीएस-पेज का उपयोग करके आगे की पुष्टि की गई।
- भैंस, भेड़ और बकरी के मांस से एमएलसी 1,2 व 3 को अलग करने के लिए 2 आयामी वैद्युतकणसंचलन (इलैक्ट्रोफोरेसिस) आधारित दृष्टिकोण को भी मानकीकृत किया गया।
- सौस-वाइड सॉसेज और आच्छादित एमु मांस के टुकड़ों जैसे मूल्य वर्धित एमु मांस के उत्पादन के लिए प्रौद्योगिकी का विकास किया गया।
- ओमेगा-3 फैटी एसिड युक्त मुर्गी मांस के उत्पादों को तैयार किया गया।
- कच्चे मांस के नमूनों को (मुर्गी, मटन, गोमांस और सुअर के मांस) खुदरा विक्रेताओं से एकत्र किया जाता है और ई. कोली के पृथक्करण के लिए संसाधित किया जाता है।
- हैदराबाद, मुम्बई और दिल्ली में वध किए गए भैंसों से जांच किए गए कुल 1,236 ग्रसिकाओं और 354 मांस नमूनों में से 462 ग्रसिकाओं (37.38%) और 26 मांस (7.35%) के नमूनों को साकौंसिस्टोसिस के लिए सकारात्मक होना पाया गया।

- एक सार्वत्रिक पहुँच पशुधन अनुमार्गणीयता डाटाबेस ([www-livestocktraceindia-com](http://www-livestocktraceindia-com)) स्थापित किया गया था और इस केंद्र द्वारा विकसित अनुमार्गणीयता प्रणाली की विभिन्न भैंस फार्मों और निर्यात कसाईखानों में प्रायोगिक जाँच की गई।
- मांस और मछली उत्पादों में चुनिंदा एंटीबायोटिक्स के विश्लेषण के लिए एचपीएलसी का उपयोग करके ठोस प्रावस्था निष्कर्षण और पद्धतियों के इष्टतमीकरण को पूरा किया गया।
- भैंस के मांस के रंग और निधानी आयु को बढ़ाने के लिए विभिन्न प्रतिसूक्ष्मजीवी संयोजनों को इष्टतम किया गया था।
- प्रजातियों की पहचान और 15% तक अपमिश्रण का पता लगाने हेतु पीसीआर आमापन के लिए पशु वसा और दूध वसा से डीएनए को पृथक करने के लिए एक पद्धति को मानकीकृत किया गया।
- कैनकॉर इनग्रेडिएंट्स लिमिटेड, केरल के साथ अनुबंध अनुसंधान परियोजना ने वायुजीवी पैकेजिंग स्थिति के अंतर्गत प्रशीतन भंडारण के दौरान कच्चे और पके हुए सुअर के मांस और चिकन पैटिस में लिपिड ऑक्सीकरण के विरुद्ध भिन्न मात्रा निर्धारण स्तर पर ऑक्सीकेनो (2.8% कार्नोसिक अम्ल और 0.55% कार्नोसोल) के रक्षी प्रभाव का प्रदर्शन किया. ऑक्सीकेनो रंग की रक्षा में भी प्रभावी है और महत्वपूर्ण प्रतिसूक्ष्मजीवी गतिविधि का प्रदर्शन किया।
- **PrARAS** बायोसाइन्सेस प्राइवेट लिमिटेड, बेंगलूर के साथ और एक अनुबंध अनुसंधान परियोजना में संशोधित सोय प्रोटीन के साथ समावेशित निम्न लागत मुर्गी उत्पाद विकसित किया गया।
- आयसीएआर-राष्ट्रीय मांस अनुसंधान केंद्र के लिए विजन-2050 प्रलेख को अंतिम रूप दिया गया।

## उद्यमशीलता प्रशिक्षण, परामर्श, समझौता ज्ञापन, कार्यशालाएं और विस्तारण गतिविधियां

- 6 मई, 2014 को कार्यस्थल पर यौन उत्पीड़न पर एक कार्यशाला।
- 10 मई, 2014 को सांख्यिकीय तथा कार्यक्रम कार्यान्वयन मंत्रालय द्वारा वित्तपोषित अनुसंधान परियोजना की अंतिम समीक्षा बैठक आयोजित की गई।
- 19-21 मई, 2014 तक पशुपालन विभाग, आंध्र प्रदेश से सात पशुचिकित्सकों के लिए "आधुनिक कसाईखानों का प्रबंधन" पर एक प्रशिक्षण कार्यक्रम का आयोजन किया गया।
- इंडियन मीट साइन्स एसोसिएशन, हैदराबाद के सहयोग से 4 अगस्त, 2014 को "भारत में मांस पशुधन की अनुमार्गणीयता" पर एक राष्ट्रीय कार्यशाला का आयोजन किया गया।
- एनआरसी-पिग गुवाहाटी के सहयोग से 19 अगस्त, 2014 को और ICAR अनुसंधान कॉम्प्लेक्स, बारापानी के सहयोग से 18 सितंबर, 2014 को "NEH राज्यों में स्थिति और मांस क्षेत्र की आवश्यकताएं" पर पणधारियों के साथ परस्पर वार्तालाप बैठक आयोजित की गई।
- छोटे तथा मध्यम उद्यमियों के लिए "मूल्य वर्धित मुर्गी उत्पाद संसाधन, पैकेजिंग" पर दो व्यावहारिक उद्यमशील प्रशिक्षण कार्यक्रम आयोजित किए गये।



- 16 अक्तूबर, 2014 को मीट ऑन व्हील्स लॉन्च किया गया तथा मूल्य वर्धित मांस उत्पादनों पर कई जागरूकता कार्यक्रम किए गए।
- इस केंद्र ने निजी कंपनियों के साथ दो अनुबंध अनुसंधान परियोजनाओं को सफलतापूर्वक पूरा किया तथा अंतिम रिपोर्ट प्रस्तुत की।
- राष्ट्रीय मांस अनुसंधान केंद्र द्वारा विकसित मूल्य वर्धित उत्पादों की लाइसेन्स और विपणन के लिए उद्यमियों के साथ दो समझौता ज्ञापन (MoU)/करारों पर हस्ताक्षर किए गए थे।
- परामर्श की मांग करते हुए मेसर्स लक्ष्मी इंजीनियरिंग वर्क्स, चेन्नै और मेसर्स वेटेरन लेबोरेटरीज, बेंगलूर के साथ डबल पर हस्ताक्षर किए गए हैं।
- पोलट्री इंडिया-2014, हैदराबाद और मीट टेक एशिया-2014 में राष्ट्रीय मांस अनुसंधान केंद्र की प्रौद्योगिकियों का प्रदर्शन-मंजूषा लगाया।
- मीट टेक-2014 के आयोजन के लिए भारतीय उद्योग परिसंघ (CII) के तमिलनाडु प्रौद्योगिकी विकास तथा प्रोन्नयन केंद्र (TNDPC) के साथ ज्ञान भागीदार के रूप में कार्य किया।
- भारतीय खाद्य सुरक्षा और मानक प्राधिकरण (FSSAI), पशुपालन विभाग, मांस निर्यात उद्योगों, कुक्कुट पालन और मांस संसाधकों, यूनिवर्सिटी पदाधिकारियों, निजी उद्यमियों आदि से पणधारियों और विशेषज्ञों के साथ संपर्क सहयोग विकसित किया और बातचीत की।
- कैंपस के भीतर और बाजू के गांव में दोनों जगह कई स्वच्छ भारत अभियान कार्यक्रम आयोजित किए गए।
- भू-दृश्य निर्माण गतिविधियां की गई, नए पानी के फव्वारे और नई टपकन सिंचाई सुविधाओं का सृजन किया गया।
- उद्यमियों और प्रशिक्षणार्थियों के लाभ के लिए नई मांस संसाधन इकाई और अतिथि गृह के साज-सामान का काम किया गया।
- इस संस्थान ने आयसीएआर स्थापना दिवस, विश्व खाद्य दिवस, हिंदी सप्ताह, स्वतंत्रता दिवस, गणतंत्र दिवस मनाया तथा कैंपस की सफाई और हरियाली करने के कई कार्यक्रम आयोजित किए।





# 1. INTRODUCTION

India has huge livestock wealth and ranks first in the world for buffalo population. India also has second largest number of cattle and goats, third largest number of sheep and fifth largest number of chicken in the world (FAO, 2014). Livestock sector serves as an important source of milk and meat proteins. It provides employment to millions of rural people and contributes enormous amount of draught power and biomass that enriches the agricultural fields of our country. India has been witnessing impressive growth in meat production with an annual production of 6.29 million tonnes during the year 2012. India is a top buffalo meat producer in the world mainly due to an expanding dairy herd, efficiency improvements, increased slaughter and price-competitiveness in the international market. In the year 2013-14, India's export of buffalo meat touched a record 26,458 crores. Buffalo meat is the second largest commodity exported from India mainly to Middle East and South East Asian nations (APEDA). India is also the second largest producer of goat meat in the world. In spite of huge potential for Indian meat sector both in domestic and export market, it is also buoyed with several challenges. Important challenges faced by the Indian meat sector which need to be addressed includes: low-productivity of livestock, inadequate infrastructure for hygienic slaughter of animals, increasing demand for meat, inadequate value addition, under utilization of animal by-products and improper disposal of waste, poor meat quality and safety concerns, lack of skilled manpower and awareness, nutritional security through meat and meat products etc.

It is projected that demand for meat in India by 2050 will increase from the present 6.29 MT to 18.1 MT and per capita meat consumption will increase to 13.8 kg from present 5.5 kg (FAOSTAT). Maximum increase in consumption of poultry meat by 2030 will happen in India compared to any other country in the world. Indian cold chain industry is expected to grow at a compound rate of 26% to reach USD 11.8 billion by 2017 (ASSOCHAM). All these developments coupled with stringent quality control measures in both domestic and export meat sector, the Indian meat export may enter into developed nations.

ICAR-National Research Centre on Meat, Hyderabad is poised to play a pivotal role for conducting basic and applied research in all aspects of meat production, processing, quality control and marketing; developing appropriate and relevant processing technologies for different value added meat products for improved palatability and enhancing product shelf life; efficient utilization of slaughterhouse by-products and waste disposal, providing need based training for scientific, managerial and technical personnel in meat and allied sectors; establishing a liaison with industry, trade, regulatory and developmental organizations operating in meat sector; providing consultancy services to entrepreneurs and serving as a national repository of



information in meat and allied sectors. To meet the emerging challenges, ICAR-NRC on Meat has taken-up research on organic meat production, meat/fat species identification, proteomics of meat quality, traceability, designer meat production, generation of data related to chemical and microbial contaminants etc. In addition to research projects, the Institute also regularly conduct training programs to entrepreneurs and veterinarians, awareness programs to butchers and meat consumers, workshops and regular interactive meetings with officials from line departments. The Institute also undertakes contract (sponsored) research with private multinational companies, consultancy projects, analytical services and provides bankable project reports to interested entrepreneurs in establishing meat products processing units.

Overall, the Centre is putting efforts in all directions to meet the challenges of the meat sector to contribute towards sustainable meat animal production and nutritional security.

## 2. VISION, MISSION AND MANDATE

### VISION

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

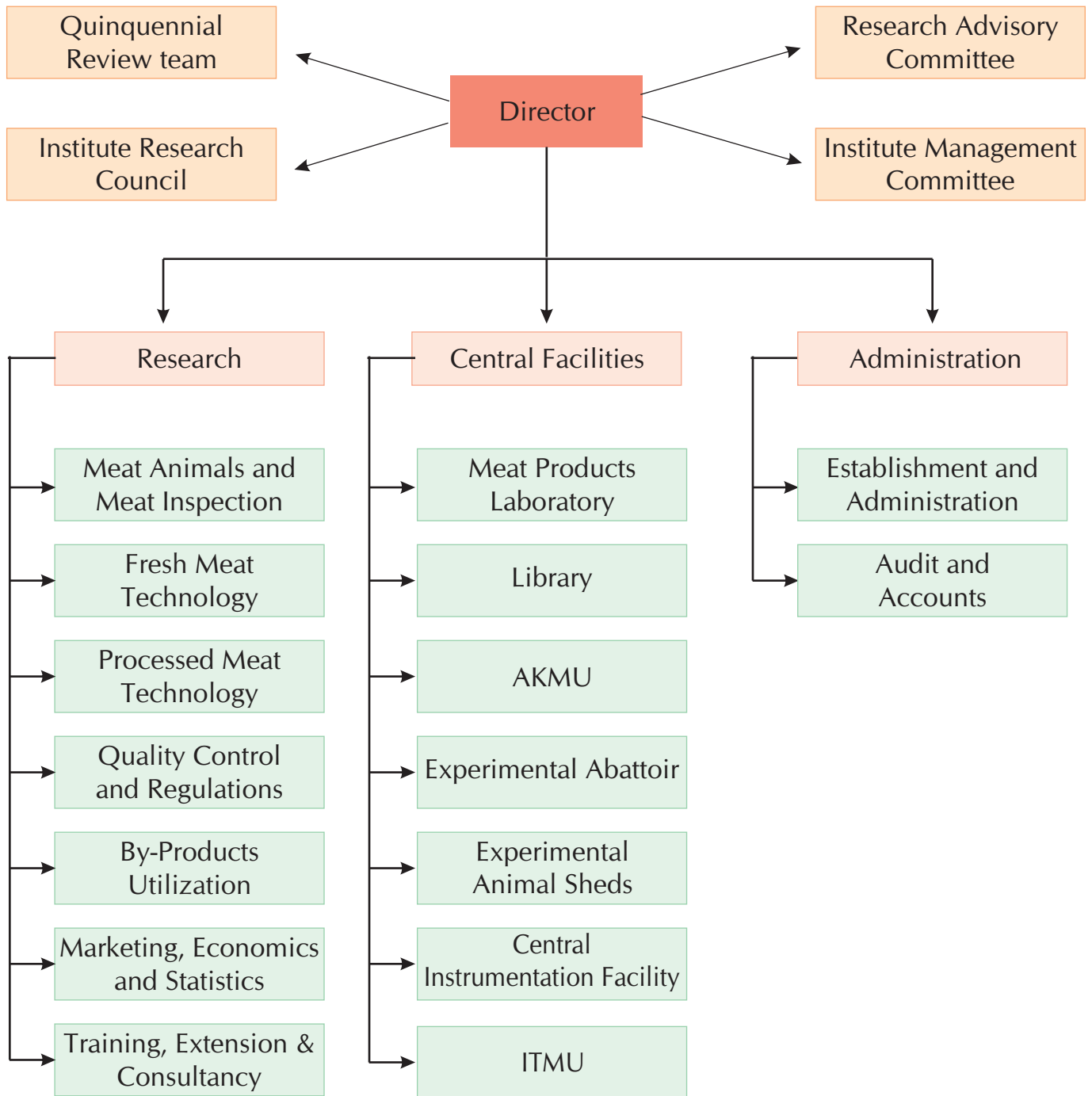
### MISSION

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

- ▲ To conduct basic and applied research in meat science and technology for development of a modern organized meat sector in the country
- ▲ To develop appropriate and relevant technologies/processes/practices for meat production, processing, value addition and utilization to contribute for sustained meat production and consumption
- ▲ To provide need based training for different levels of personnel in meat and allied sectors.
- ▲ To establish a liaison with industry, trade, regulatory and developmental organizations operating in meat sector.
- ▲ To support bilateral and international programmes
- ▲ To serve as a national repository of information in meat and allied sectors.

### 3. ORGANISATIONAL SETUP



## 4. STAFF STRENGTH (2014-15)\*

Staff	Sanctioned	Filled
Scientific	16	13
Technical	5	5
Administrative	14	8
Skilled Supporting	2	0
<b>Total</b>	<b>37</b>	<b>26</b>

\* As on 31<sup>st</sup> March, 2015

### 4.1 BUDGET: (FY 2014-15) IN LAKH

S.No	Head	Plan		Non Plan	
		Sanctioned	Utilized	Sanctioned	Utilized
1	Establishment			285.00	273.06
2	Contingencies	72.00	70.71	90.00	85.52
3	Equipment	12.05	12.04	10.00	8.73
4	Furniture and Fixtures	0.42	0.42	0.00	0.00
5	Library	0.02	0.02	0.00	0.00
6	Works	14.01	13.90	0.00	0.00
7	TA	4.10	4.10	9.00	6.48
8	HRD	0.90	0.90	0.00	0.00
9	P Loans & Advances	0.00	0.00	5.00	2.09
10	Pension & ORB	0.00	0.00	30.00	18.61
11	NEH	25.00	0.00	0.00	0.00
	<b>Total</b>	<b>128.50</b>	<b>102.09</b>	<b>429.00</b>	<b>394.48</b>

## 5. RESEARCH HIGHLIGHTS

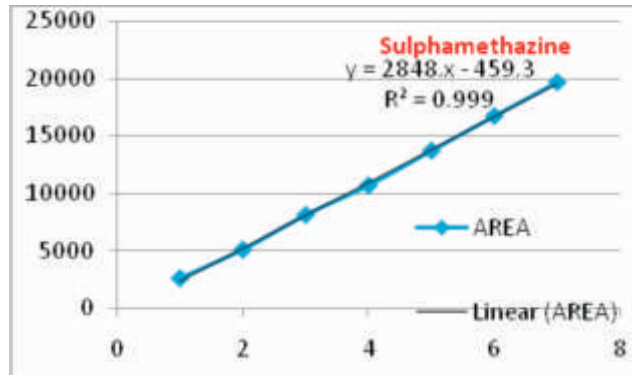
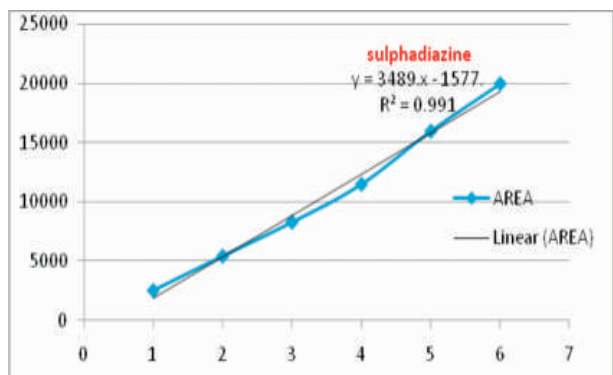
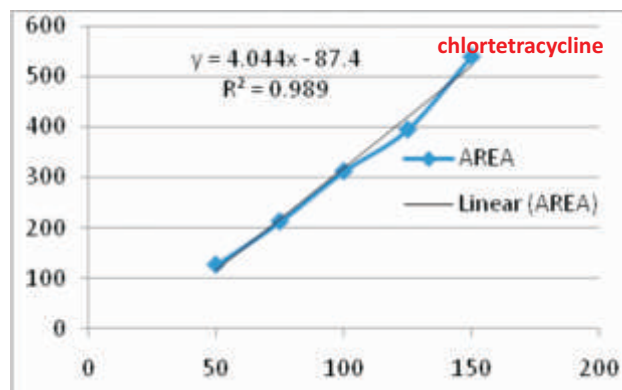
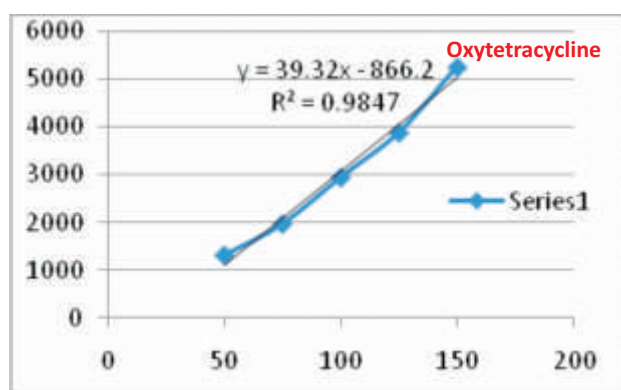
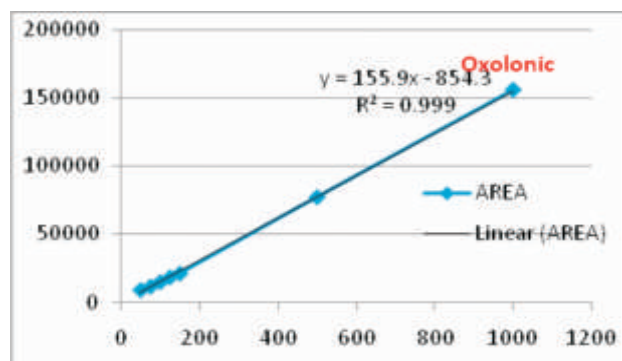
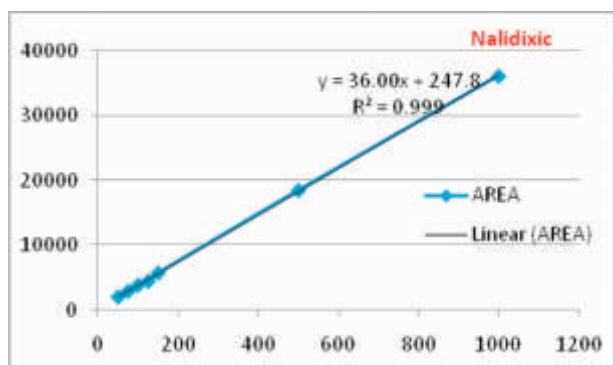
### 5.1 Institute Projects

**5.1.1 Project title** : Estimation of antibiotics residues in fishes and poultry

**Principal investigator** : Dr. G. Venugopal, Principal Scientist

**Co-PIs** : Dr. M. Muthukumar and Dr. P. Baswa Reddy

Adopting HPLC method, the procedures for some of the antibiotics viz., Fluoroquinolones (Nalidixic acid, Oxolonic acid), Sulphonamides (Sulphadiazine, Sulphamethazine) and Tetracycline (Oxytetracyclines and Chlortetracycline) were standardized. The linearity studies of antibiotics standards and spiked poultry meat matrix were conducted and recovery studies are under progress.



Linearity graph for antibiotics standard

**5.1.2 Project title : Detection of animal derived materials in foods and feeds through molecular techniques**

**Principal investigator : Dr. S. Vaithyanathan, Principal Scientist**

**Experiment 1 : DNA extraction from binary mixtures of tallow and milk fat (ghee)**

Tallow / milk fat (cow ghee) and binary mixtures were thoroughly mixed with extraction buffer and centrifuged at 13000 rpm for 20 min at room temperature. The supernatant was discarded and the pellet centrifuged at 13000 rpm for 20 min at room temperature. The precipitate obtained was subjected to DNA extraction by PCI method and the DNA concentration was determined by Nanospectrophotometer followed by the PCR assay using mt D loop (cow and buffalo specific). DNA was successfully extracted from the tallow and ghee, and the yield values are presented below.

**DNA extracted from binary mixtures of tallow and ghee**

	Binary mixture (%)							
Tallow (%)	0	5	10	15	20	25	30	
Tallow	0.0	0.5	1.0	1.5	2.0	2.5	3.0	
Ghee	10	9.5	9.0	8.5	8.0	7.5	7.0	
DNA (ng/ $\mu$ l)	109.84 $\pm$ 25.37	92.60 $\pm$ 23.46	93.50 $\pm$ 36.81	127.06 $\pm$ 18.30	114.37 $\pm$ 37.30	130.85 $\pm$ 11.33	128.56 $\pm$ 41.65	
	Binary mixture (%)							
Tallow (%)	35	40	50	60	70	80	90	100
Tallow	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Ghee	6.5	6.0	5.0	4.0	3.0	2.0	1.0	0.0
DNA (ng/ $\mu$ l)	115.88 $\pm$ 50.82	148.84 $\pm$ 40.56	141.86 $\pm$ 68.10	119.87 $\pm$ 48.12	110.70 $\pm$ 13.13	164.89 $\pm$ 80.41	165.95 $\pm$ 46.35	156.74 $\pm$ 62.46

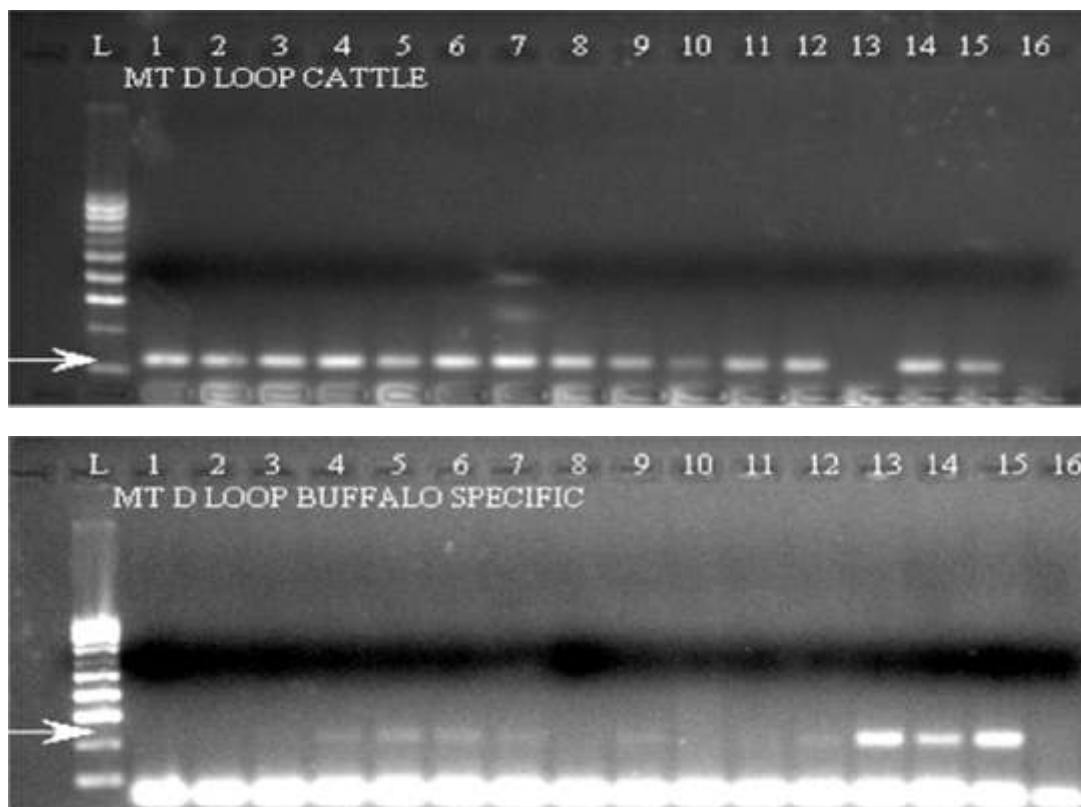
**Experiment 2 : PCR amplification of mt D loop primer using DNA from binary mixtures of milk fat (ghee) and tallow**

Primer of mitochondrial mt D loop were made and amplified. The PCR reaction mixtures (a total volume of 25  $\mu$ l consisting 2.5  $\mu$ l 10X PCR assay buffer, 1.0  $\mu$ l 25mM MgCl<sub>2</sub>, 1  $\mu$ l each of both



the forward and reverse primers (10 pm/l), 0.5  $\mu$ l of dNTP mix (10 mM), 0.25  $\mu$ l of TaqDNA Polymerase (3 U/l), 5  $\mu$ l DNA template and sterile nuclease free water to make the final volume 25 l) prepared were subjected to the following cycling conditions:

PCR cycling parameters: denaturation at 94°C for 40 s. To avoid any non-specific amplification, a touch-down PCR was used with an initial annealing temperature of 65°C. In subsequent cycles, the annealing temperature was then gradually reduced by 1°C until it reached 55°C. At 55°C, 35 cycles were used. In each cycle, annealing was followed by an extension step at 72°C for 30 s. The final extension was performed at 72°C for 10 min in a thermocycler. PCR assay results are shown below.



### PCR amplification of mt D loop primers by DNA extracted from binary mixtures of cow ghee and tallow

Cow ghee (%) 1 = 100; 2 = 95; 3 = 90; 4 = 85; 5 = 80; 6 = 75; 7 = 70; 8 = 65; 9 = 60; 10 = 50; 11 = 40; 12 = 30; 13 = 20; 14 = 10; 15 = 0. Tallow (%) 1 = 0; 2 = 5; 3 = 10; 4 = 15; 5 = 20; 6 = 25; 7 = 30; 8 = 35; 9 = 40; 10 = 50; 11 = 60; 12 = 70; 13 = 80; 14 = 90; 15 = 100, 16 = negative control

The PCR assay has shown that DNA isolated from tallow and milk fat (cow ghee) and binary mixtures could amplify mt D loop (amplicon size-cow specific 126 bp and buffalo specific 226 bp) primers. The results further showed that amplification of buffalo specific primer was observed from 15% level of inclusion of tallow in the milk fat.

**5.1.3 Project title** : Studies on safety of muscle food based products with reference to carcinogenesis

**Principal investigator** : Dr.A.R.Sen / Dr. M. Muthukumar

**Co-PI** : Dr.B.M. Naveena

### **Standardization of procedure for development of cured and smoked value added meat products**

The process for development of cured and smoked tilapia fish employing tumbling was standardized. The treatment groups includes control (injection and dipping in brine for 24 h), T1 (brine injection and tumbling twice for 30 min with the gap of 20 mins in between) and T2 – (Injection, tumbling for 20 mins and dipping in brine for 12 h). The product developed by injection, tumbling and dipping in brine showed appealing colour than others and was chosen for further studies. The evaluation of quality attributes in terms of pH, TBA, TPC, PPC and instrumental colour revealed that the Tilapia fish prepared by accelerated curing is very well acceptable up to 20 days of refrigerated storage.



**Cured and smoked Tilapia fish**

## Physico-chemical and sensory attributes of cured and smoked Tilapia fish

Attributes	T1	T2	T3
pH	6.51	6.48	6.73
Cooking yield (%)	75.22	79.76	78.90
Total pigment (ppm)	29.92 <sup>a</sup>	50.32 <sup>b</sup>	28.56 <sup>a</sup>
Nitrosopigments (ppm)	7.25 <sup>b</sup>	4.93 <sup>a</sup>	11.02 <sup>c</sup>
L*	54.02	52.35	55.97
a*	14.21 <sup>a</sup>	16.78 <sup>b</sup>	18.28 <sup>c</sup>
b*	57.82 <sup>b</sup>	52.61 <sup>a</sup>	60.62 <sup>b</sup>
Moisture	72.85	72.44	74.20
Protein	20.50	19.02	18.94
Fat	5.34	4.53	4.79
Ash	2.37 <sup>a</sup>	3.81 <sup>b</sup>	3.25 <sup>b</sup>
Appearance & colour	6.26	6.00	6.35
Saltiness	6.0 <sup>a</sup>	6.0 <sup>a</sup>	6.5 <sup>b</sup>
Flavour	6.35	6.0	6.4
Texture	6.35	6.0	6.4
Juiciness	6.4	6.0	6.4
Overall acceptability	6.35	6.0	6.35

**5.1.4 Project title** : **Studies on development of natural preservative system for improving microbiological safety and quality of buffalo meat**

**Principal Investigator** : **Dr. Y. Babji, Principal Scientist**

**Co-PIs** : **Dr. I. Prince Devadason and Dr. S. Vaithyanathan**

**Experiment 1 : Physico-sensory and microbiological quality of aerobically packed buffalo meat under refrigeration storage ( $4 \pm 1^\circ\text{C}$ )**

Physical profiles viz., the initial pH of aerobically packed buffalo meat on 0 day was  $5.56 \pm 0.08$  whereas it increased to  $6.51 \pm 0.005$  on day 4 with increases in water activity (initial aW on day 0 was  $0.934 \pm 0.002$  and on day 4 it was  $0.950 \pm 0.009$ ). The initial objective colour scores on day 0 was  $7.9 \pm 0.05$  and it decreased to  $7.3 \pm 0.13$  on day 4. While the odour scores on day 0 was  $7.9 \pm 0.02$  it decreased to  $7.8 \pm 0.05$  on day 4. The overall acceptability score on day 0 was  $7.9 \pm 0.02$  and it decreased to  $7.8 \pm 0.05$  on day 4. The increase in spoilage and pathogenic flora count (log/g) varied between 3.0 on day 0 to 4.9 on day 4 with a shelf life of 4 days at  $4 \pm 1^\circ\text{C}$ .

**Experiment 2: Physico-chemical, sensory, instrumental traits and microbial quality of buffalo meat pre-treated with natural preservatives under vacuum packaging under refrigerated storage ( $4 \pm 1^\circ\text{C}$ ).**

Though the objective colour scores were bright red (7.0) for all treatments including control (1% acetic acid) on day 0, the colour scores for 1% chitosan+1.5% EDTA+1.5% lysozyme+0.5% lemon grass essential oil (ELCL) was bright red (7.0) maintained throughout 42 days and it had a desirable (a score of 7) to slightly desirable (a score of 6) odour scores and overall acceptability scores of 7 to 5 throughout 42 days of vacuum storage compared with other treatments. Instrumental colour,  $a^*$ (redness) values of buffalo meat treated with 1% chitosan (CH) singly and in association with other treatments increased throughout 42 days of storage at  $4 \pm 1^\circ\text{C}$ . On day 0, the microbial counts were very low in ELCL compared with other treatments and the ELCL maintained low counts throughout 42 days of vacuum storage compared with its counterpart treatments. The study revealed that buffalo meat samples dipped for 2 minutes with 1% chitosan+1.5% EDTA+1.5% lysozyme+0.5% lemon grass essential oil (ELCL) not only improved colour, extended shelf life up to 42 days by reducing microbial counts but it also acted as the best natural antimicrobial combination treatment for market buffalo meat.

**5.1.5 Project title** : Emu meat quality, processing and product development towards a niche market

**Principal investigator** : Dr. B.M. Naveena, Senior Scientist

**Co-PIs** : Dr. S. Vaithyanathan, Dr. M. Muthukumar and Krishna Emu Products Ltd., Vijayawada

Experiments were conducted to develop processing technology for sous vide cooked emu-chicken sausage (Figure 1) and evaluate their storage stability at refrigeration temperature. The Experiments were also conducted to develop processing methodology for enrobed emu nuggets (Figure 2) and evaluate their shelf-life at refrigeration and frozen storage. The sous vide cooked emu-chicken combination sausages were stable at refrigeration temperature beyond 3 months relative to aerobic and vacuum packed samples which are stable for 20 and 90 days, respectively. The microbial load (Figure 3) and lipid oxidation induced oxidation remained below the limit throughout the storage. The enrobed and fried emu meat nuggets were stable upto 30 days relative to only enrobed nuggets that were spoiled on 30<sup>th</sup> day.



**Fig 1. Emu-chicken combination sausages**



**Fig 2. Enrobed and fried emu meat nuggets**

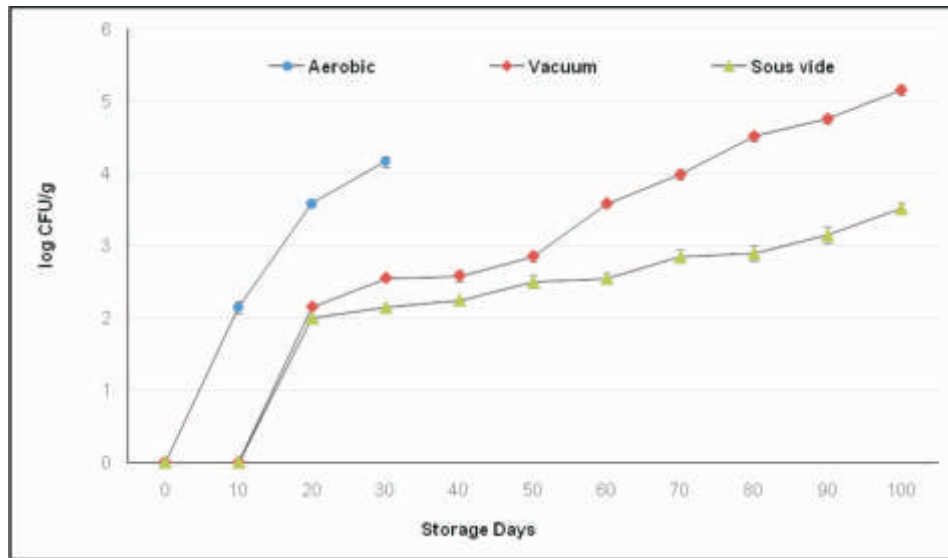


Fig 3. Changes in total plate counts of emu-chicken combination sausage stored under different packaging conditions. Standard error bars are indicated (n = 3).

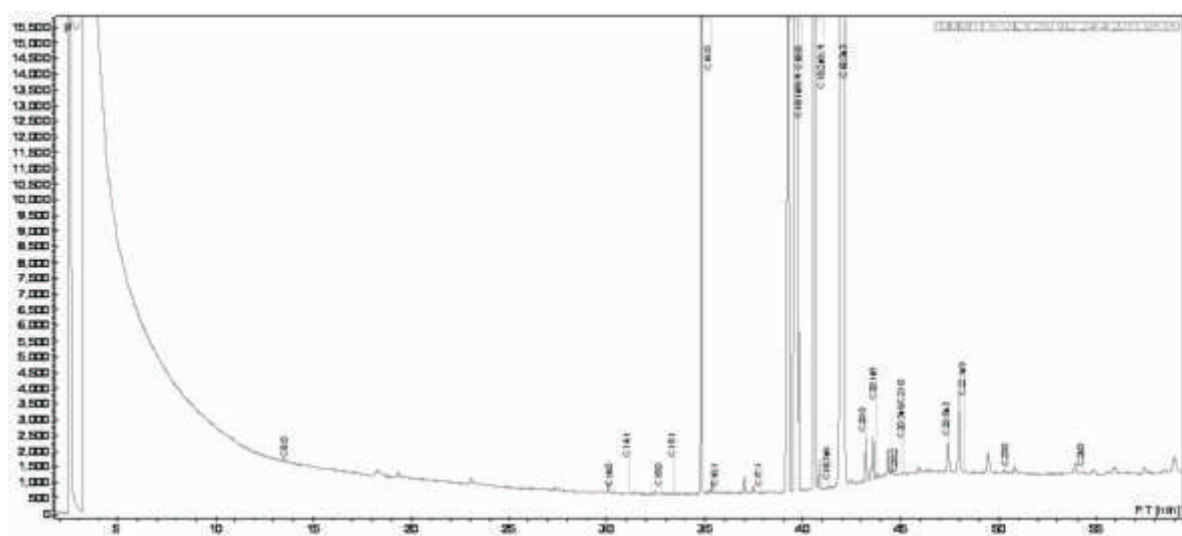


**5.1.6 Project title : Development of healthier meat products enriched with omega 3 fatty acids and antioxidant intervention for improved shelf life**

**Principal Investigator : Dr.M.Muthukumar, Senior Scientist**

**Co-PIs : Dr.A.R.Sen and Dr.B.M.Naveena**

The fatty acid profile of chicken nuggets prepared with 7.5 % of sun flower oil and 2.5 % flax seed oil was determined. There was a significant increase (24%) in the levels of omega 3 fatty acid - linolenic acid (C18:3) in the chicken nuggets prepared with flax seed oil compared to control chicken nuggets made with 10% sun flower oil.



**Fatty acids profile of chicken nuggets incorporated with flax seed oil**

**Fatty acids profile of flax seed oil incorporated chicken nuggets**

Name	Palmitic (Hexadecanoic) C16	Stearic (n-Octadecanoic) C18	Oleic (C18:1)	Linolenic (C18:3)	Linoleic (C18:2)	Arachidic C20 (Eicosanoic)
Flax seed oil	5.23	5.43	20.50	54.64	13.72	0.24
Control Nugget	14.84	5.87	34.01	0.28	40.31	0.34
Nugget with flax seed oil	13.43	5.75	32.81	6.93	37.67	0.29

**5.1.7 Project title** : **Production of designer meat through nutritional manipulation in small ruminants and poultry**

**Principal investigator** : **Dr P Baswa Reddy, Senior Scientist**

**Co-PIs** : **Dr D B V Ramana, Dr G Venugopal, Dr M Muthukumar**

The effect of different roughage and concentrate ratios with different protein and energy levels in the diets of Deccani ram lambs on dressing yield and meat quality was undertaken. Total of thirty three animals were divided into three groups of eleven each. Under stall feeding, they were offered adlib chaffed green fodder along with measured quantity of concentrate feed. Animals in first, second and third group were offered concentrate mixture @ 0.5%, 1% and 2% of their average group body weights, respectively. After completion of the feeding experiment, the animals were slaughtered to study the carcass characteristics and meat quality parameters (Table 1). The fatty acid composition of meat samples is being studied and the initial trends are presented in Table 2. The growth rate was higher in the third group, but it was found that the animals in the third group accumulated more fat in their body resulting in poor feed conversion efficiency. Animals in the third group showed less meat and more fat as percentage of chilled carcass. Animals in the first group have significantly less MUFA content and more PUFA, n-3 and n-6 fatty acids in the meat when compared to the other two groups. Based on the results, it can be inferred that concentrate supplementation beyond 1% of body weight in deccani ram lambs has no beneficial effect either on meat yield or on meat quality.

**Table 1. Effect of concentrate feeding on dressing percentage, meat, bone and fat contents in Deccani ram lambs**

<b>Carcass traits</b>	<b>Group-1 (n = 10)</b>	<b>Group-2 (n = 11)</b>	<b>Group-3 (n = 11)</b>
Dressing %	43.26 + 4.25	45.56 + 4.46	44.36 + 4.3
Hot carcass wt (Kg)	7.38 + 1.33	8.37 + 1.54	8.29 + 1.82
Chilled carcass wt (Kg)	6.98 + 1.28	7.69 + 1.6	7.84 + 1.79
Total meat wt (Kg)	4.01 + 1.1	4.6 + 1.4	4.42 + 1.66
Total bone wt (Kg)	2.67 + 0.57	2.8 + 0.5	2.89 + 0.41
Total fat wt (Kg)	0.3 <sup>a</sup> + 0.12	0.29 <sup>a</sup> + 0.17	0.53 <sup>b</sup> + 0.18
Meat as % of chilled carcass	57.05 <sup>a</sup> + 8.13	58.75 <sup>a</sup> + 8.76	54.75 <sup>b</sup> + 9.7
Bone as % of chilled carcass	38.73 + 7.55	37.19 + 6.43	38.08 + 7.12
Fat as % of chilled carcass	4.23 <sup>a</sup> + 1.22	4.05 <sup>a</sup> + 2.54	7.2 <sup>b</sup> + 2.95



**Table 2. Effect of concentrate feeding on fatty acid profile of meat (% of total fatty acids) in Deccani ram lambs**

Fatty acids	Group-1 (n = 6)	Group-2 (n = 4)	Group-3 (n = 4)
SFA	77.8	76.3	76.9
MUFA	16.5 <sup>a</sup>	20.6 <sup>b</sup>	20.8 <sup>b</sup>
PUFA	5.6 <sup>a</sup>	3.1 <sup>b</sup>	2.2 <sup>b</sup>
n3	0.2 <sup>a</sup>	0.05 <sup>b</sup>	0.03 <sup>b</sup>
n6	5.39 <sup>a</sup>	3.05 <sup>b</sup>	2.17 <sup>b</sup>

**5.1.8 Project title** : **Organic meat production system for sustainable sheep husbandry and promotion of consumer health**

**Principal investigator** : **Dr. P. Baswa Reddy, Senior Scientist**

**Co-PIs** : **Dr. D. B. V. Ramana, Dr C Ramakrishna, Dr M Muthukumar and Dr. P. K. Pankaj**

The project work on “Organic Meat Production System” is being carried out in collaboration with ICAR-CRIDA, Hyderabad at Hayatnagar Research Farm of CRIDA from 2014. An area of 0.8 hectares is been utilized for production of organic CO-4 grass and hedge Lucerne fodder without any chemical fertilizers or pesticides. Organic certification for the fodder has been done.

Breeding stock of Deccani sheep for organic rearing has been selected from livestock farm of CRIDA. Currently 24 animals including 16 adults (13 females and 3 males) and 8 kids (5 males and 3 females) are reared under cut and carry system with organically produced fodder. The process for organic certification of sheep is in progress.



**Organically raised fodder & sheep**

**5.1.9 Project title** : Study on prevalence, characterization and antibiotic resistance of *Campylobacter*, *Salmonella*, *E.coli* and *L. monocytogenes* in raw meat and ready to eat meat products.

**Principal investigator** : Dr. L. R. Chatlod, Scientist

**Co-PIs** : Dr. B. M. Naveena and Dr.M. Muthukumar

A total of 124 raw meat samples from retail meat shops were collected and processed for isolation of *E.coli* (Table 1). Confirmation by biochemical tests is under progress.

**Table 1. Incidence of *E. coli* in meat samples collected from Hyderabad**

S. No.	Meat sample	No. of samples analysed
1	Chicken	60
2	Chevon	30
3	Beef	23
4	Pork	11
	Total	124

**Work done at collaborating centers:**

**a. College of Veterinary Science, GADVASU, Ludhiana, Punjab**

A total of 60 samples and 10 each of the following ready-to-eat products and raw meat were investigated (Table 2).

**Table 2. Incidence of meat borne organisms in meat samples**

S. No.	Name of meat product	<i>Campylobacter</i>	<i>Salmonella</i>	<i>E.coli</i>	<i>L. monocytogenes</i>
1.	Raw meat samples	01 (10)	04 (40)	03(30)	01(10)
2.	Chicken tikka	-	01 (10)	02 (20)	-
3.	Tandoori chicken	-	02 (20)	01 (10)	-
4.	Fried chicken	-	-	-	-
5.	Gravy based meat products	01 (10)	03 (30)	02 (20)	01 (10)
6.	Soup	-	01 (10)	01 (10)	-

\*Number in parentheses represent percentage

### b. College of Veterinary and Animal Sciences, Parbhani, Maharashtra

Percentage of *Campylobacter jejuni* isolates from chicken meat sold at retail shops:

**Table 3. Incidence of meat borne organisms in meat samples**

Sr. No.	No. of samples tested	No. of positive samples	Percentage of positive samples
1	17	2	11.76
2	14	3	21.42
3	13	4	30.77
4	12	6	50.00
5	11	2	18.18
6	15	5	33.33
Total	82	22	26.82

### c. Nagpur Veterinary College, Nagpur, Maharashtra

Meat Samples	No. of Samples	Isolation for <i>L. monocytogenes</i>	Pathogenicity profile				Antibiogram		
			Haemolysin production on 7% SBA	CAMP with <i>S. aureus</i>	PI-PLC producer	Detection of hlyA gene at 456 bp	Sensitive	Moderate Resistant	Resistant
Chevon	50	01	Positive	Positive	Positive	Positive	Penicillin G, Ampicillin, Ceftriaxone Cloxacillin	Erythro-mycin Gentamycin Norfloxacin Oxytetracyclin Vanco-mycin	Kanamycin Cephotaxime
Pork	50	02	Positive	Positive	Positive	Positive			

### d. College of Veterinary and Animal Sciences, Udgir, Maharashtra

A total of 146 samples of raw goat meat were collected from slaughterhouse. 48.63% samples were positive for *E. coli* and 5.47% samples were found positive for *Salmonella enterica*.

**5.1.10 Project title : Economic evaluation of processed chicken meat products**

**Principal investigator : Mrs. K. Varalakshmi, Scientist**

**Co-PIs : Dr. Y. Babji, Dr. I. Prince Devadason and Dr. R. S. Rajkumar**

Investment analysis was carried out for different types of meat processing plants with capacities ranging from 10 kg/day to 400 kg/day working @ 8 hours shift for 300 days with utilized capacity of 60% and 70% in the 1<sup>st</sup>, 2<sup>nd</sup> years and levelling off to 80% from 3<sup>rd</sup> year onwards respectively. Investment analysis of non-mechanized processing plants (capacities from 10 kg/day to 30 kg/day) showed that functional products yield highest NPV ranging from Rs. 0.90 lakhs to Rs. 3.36 lakhs with IRR of 14-16% and B-C ratio of 1.10-1.18 and DSCR of 1.8-1.9. The corresponding figures for mechanized processing plants (capacities from 50 kg/day to 400kg/day) are Rs. 6.60-75.73 lakhs, 16-31%, 1.14-1.8 and 1.9-2.8 respectively. Among the emulsion products, enrobed eggs was most profitable product for both categories (non-mechanized and mechanized) of plants with NPV of 8.04-13.45 and IRR of 22-23% and B-C ratio of 1.43-1.39 and DSCR of 2.3-2.2 for non-mechanized and Rs. 30.94-254.89 lakhs of NPV, 23-34% of IRR, 1.46-1.94 of B-C ratio and 2.3-3.0 of DSCR for mechanized processing plants.

### Financial feasibility measures of chicken meat products

Type of Product	Non Mechanized units				Mechanized units			
	NPV (Rs. lakhs)	IRR (%)	B-C ratio	DSCR	NPV (Rs. lakhs)	IRR (%)	B-C ratio	DSCR
Emulsion (Prime)	0.73-3.03	14-16%	1.08-1.16	1.8-1.9	7.24-71.38	16-30%	1.16-1.76	1.9-2.8
Emulsion (Choice)	0.49-2.54	13-15%	1.05-1.13	1.8-1.9	6.43-64.95	16-29%	1.14-1.7	1.9-2.7
Emulsion (Economy)	0.21-1.99	13-15%	1.02-1.1	1.7-1.8	4.37-57.92	14-27%	1.09-1.62	1.8-2.6
Restructured	0.78-2.05	14-14%	1.06-1.08	1.8-1.8	8.73-86.33	16-31%	1.14-1.8	1.9-2.8
Emulsion Nuggets	0.28-1.09	13%	1.03-1.05	1.7-1.8	6.12-75.1	15-30%	1.12-1.77	1.9-2.8
Croquettes	0.27-1.18	13%	1.03-1.06	1.7-1.8	5.30-66.67	15-29%	1.10-1.7	1.8-2.7
Enrobed Eggs	8.04-13.45	22-23%	1.43-1.39	2.3-2.2	30.94-254.89	23-34%	1.46-1.94	2.3-3.0
Kebab	0.66-2.33	14-15%	1.06-1.11	1.8-1.9	6.94-75.39	15-30%	1.13-1.77	1.9-2.8
Meat Balls	0.59-1.76	13-14%	1.05-1.09	1.8-1.8	7.45-74.35	16-30%	1.15-1.77	1.9-2.8
Chicken Vada	1.23-3.22	15-17%	1.14-1.18	1.9-2	8.62-78.16	17-33%	1.18-1.9	2.0-3.0
Chicken Samosa	1.41-2.45	15%	1.13-1.11	1.9-1.9	9.29-92.1	16-31%	1.17-1.8	1.9-2.8
Chicken Patty - NE	1.68-8.57	15-17%	1.12-1.2	1.9-2.0	6.02-72.58	15-29%	1.10-1.71	1.8-2.7
Sausage (Cooked)	0.73-3.44	14-16%	1.06-1.17	1.8-1.9	9.62-92.91	16-34%	1.18-1.92	1.9-3.0
Sausage (Smoked)	1.11-2.79	14-15%	1.09-1.12	1.8-1.9	10.72-91.83	17-32%	1.20-1.83	2.0-2.9
Retort nuggets					10.61-79.48	16-29%	1.16-1.7	1.9-2.7

NPV: Net Present Value, BC ratio: Benefit cost ratio, IRR: Internal Rate of Returns, DSCR: Debt Service Coverage Ratio, Chicken Patty -NE: Not Enrobed

## 5.2 EXTERNALLY FUNDED RESEARCH PROJECTS

**5.2.1 Project Title** : Studies on prevalence of zoonotic sarcocystosis in export buffalo meat (APEDA)

**Principal Investigator** : Dr.C.Ramakrishna, Senior Scientist

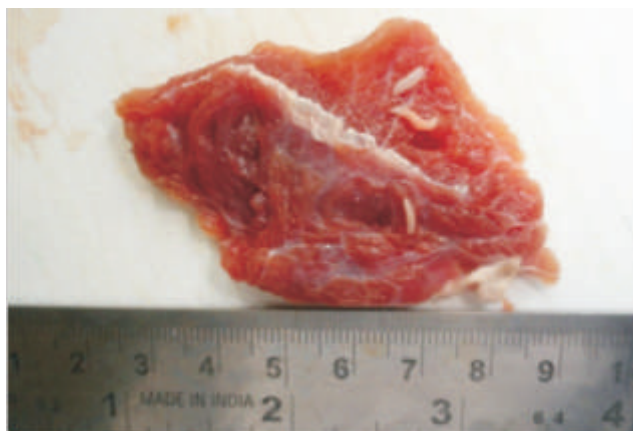
**Co-PIs** : Dr.L.R. Chatlod, Dr.S.Vaithiyanathan and Dr.M.Muthukumar

### Experiment 1: Prevalence of Sarcocystosis in buffaloes

Out of a total of 1,236 oesophagus and 354 meat samples examined from slaughtered buffaloes at Hyderabad, Mumbai and Delhi, 462 oesophagus (37.38%) and 26 meat (7.35%) samples were positive for Sarcocystosis.

### Prevalence of sarcocystosis in buffaloes

Location	Oesophagus			Meat		
	No. examined	No. positive	Positive percentage	No. examined	No. positive	Positive percentage
Hyderabad	910	323	35.50	96	9	9.38
Mumbai	256	132	51.56	250	17	6.8
Delhi	70	7	10.00	8	0	0
Total	1,236	462	37.38	354	26	7.35



**Sarcocystosis in buffalo meat**

### Experiment 2: Identification of zoonotic Sarcocystosis (*S. hominis*) and its prevalence

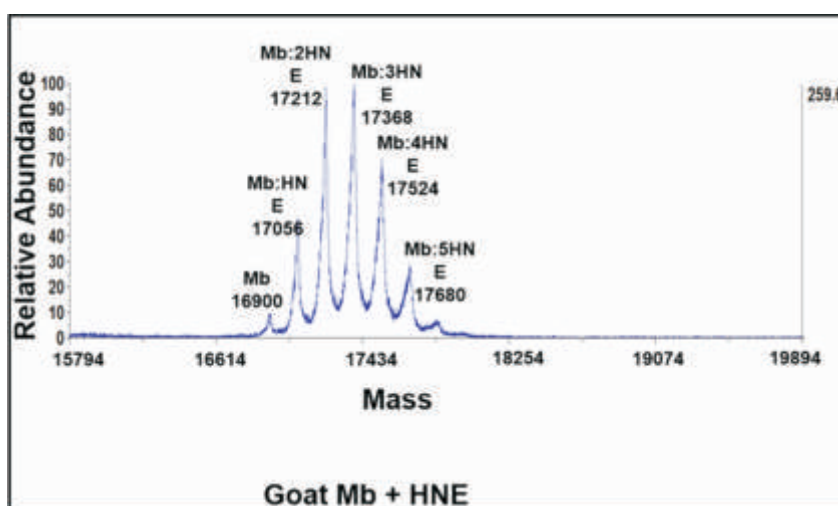
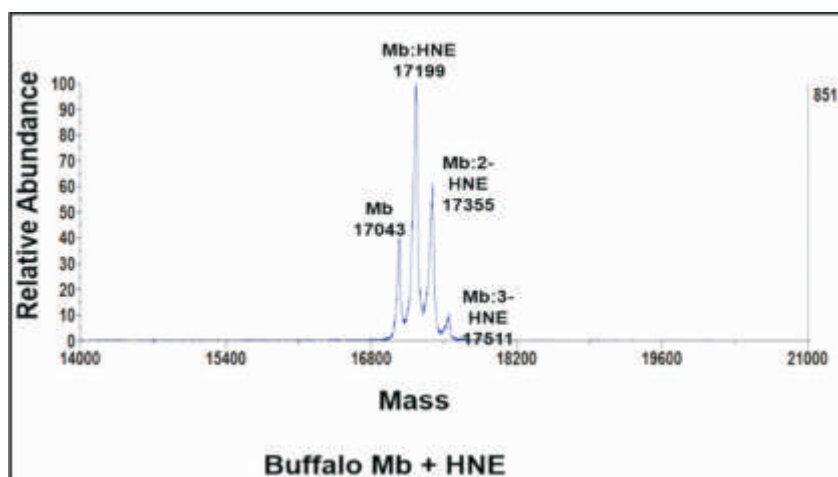
DNA isolation from 121 Sarcocysts collected from different regions of the country was done. PCR amplification and RFLP is under process.

**5.2.2 Project title : Proteomics of lipid oxidation induced oxidation of buffalo and goat meat myoglobins (DST)**

**Principal investigator : Dr. B.M. Naveena, Senior Scientist**

The study has demonstrated the species-specific variation in 2-Dimensional gel electrophoresis properties of buffalo and goat Mb's and the ability of peptide mass fingerprinting (PMF) in identifying these proteins. Significantly greater ( $P < 0.05$ ) thermostability of buffalo Mb relative to goat Mb at typical meat cooking conditions (63, 71 and 77 °C) was observed. Reaction of buffalo and goat myoglobin with 4-hydroxy nonenal (HNE) resulted in significant ( $P < 0.05$ ) formation of metmyoglobin compared to control myoglobin (without HNE).

It was concluded that, buffalo Mb is more ( $P < 0.05$ ) stable compared to goat Mb in presence of oxidizing lipids.



**MALDI-TOF mass spectra of buffalo and goat myoglobins with HNE**



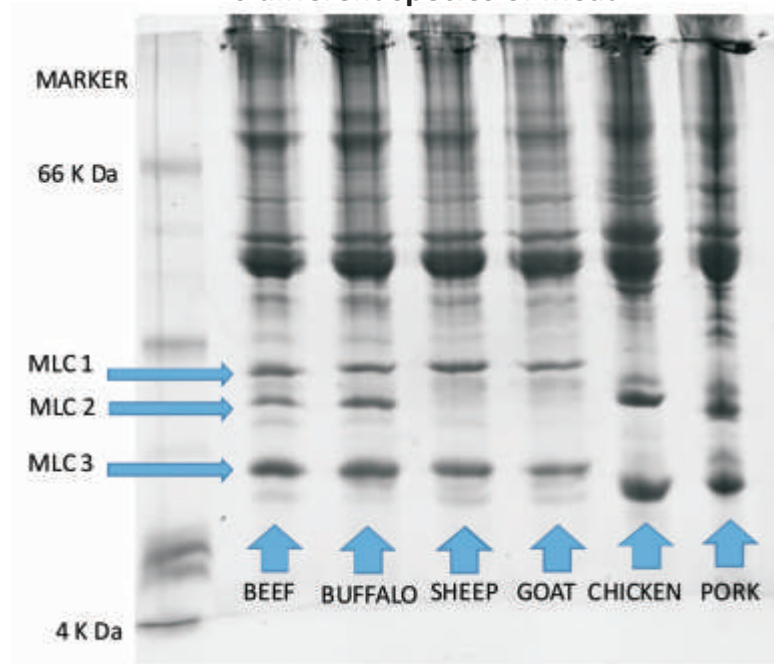
**5.2.3 Project title** : **Identification of species-specific peptide biomarkers using high throughput proteomic approaches (DBT)**

**Principal investigator** : **Dr. B.M. Naveena, Senior Scientist**

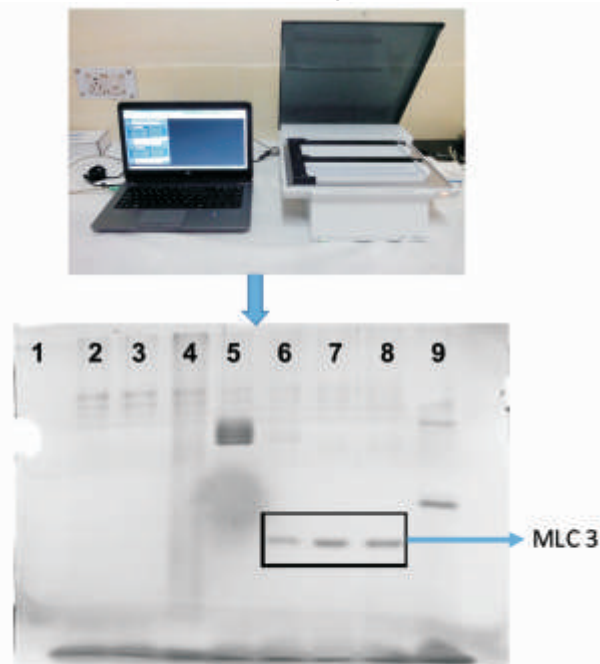
**Co-PI** : **Dr. M. Muthukumar**

Salt soluble, water soluble and total proteins were extracted and purified from 6 different species of meat (buffalo, cattle, bullock, sheep, goat, pig and chicken). Successful separation of Myosin light chain1, 2 and 3 was done using SDS-PAGE. The OFFGEL electrophoresis procedure was standardized using 24 cm, pH 3-7 strip. The location of MLC-3 was consistently obtained at 6 or 7<sup>th</sup> well of OFFGEL fractionator and further confirmed using SDS-PAGE. The 2-dimensional electrophoresis based approach for separating MLC-1, 2 & 3 from buffalo, sheep and goat meat was also standardized.

**SDS-PAGE Profile of myofibrillar protein extract from 6 different species of meat**



**OFFGEL Electrophoresis**



**Myosin light chain-3 (MLC3) separation using OFFGEL electrophoresis**

- Project title** : **Creation of awareness on clean meat production and value addition (RKVY)**
- Project leader** : **Dr.V.V.Kulkarni**
- Principal investigator** : **Dr. M. Muthukumar, Senior Scientist**
- Co-PIs** : **Dr. G. Venugopal, Dr. S. Vaithyanathan, Dr. C. Ramakrishna, Dr. B. M. Naveena, Dr. P. Baswa Reddy and Dr. L. R.Chatlod**

Well-equipped mobile exhibition cum sale unit was fabricated with facility for audio-visual aids (LCD projector, DVD player, T.V. and public addressing system) and meat products preparation and storage (Deep fat fryer, microwave oven, working table, fridge, deep freezer and generator). This vehicle is used for creating awareness on meat handling, consumption and also for selling meat and meat products in the ICAR institutions and residential colonies.



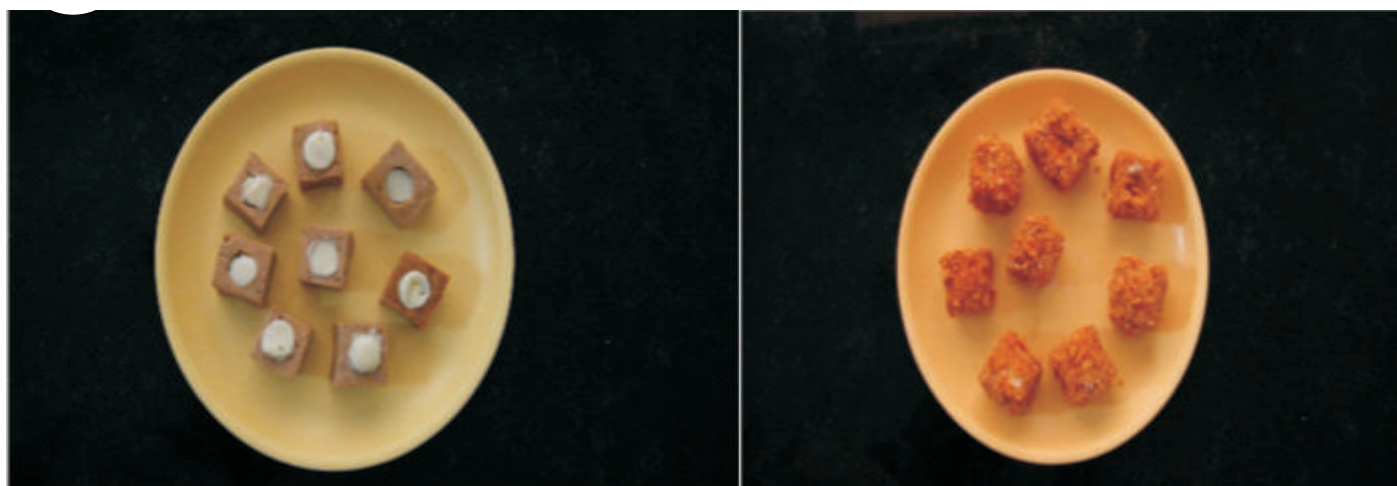
**Meat on wheels at NAARM, Hyderabad**

Awareness programmes on handling of meat and meat products, nutritional aspect and value added meat products were organised as a part of ICAR foundation day at NRCM Campus on 16<sup>th</sup> July, 2014 and at Meat Tech Asia, Bangalore on 23<sup>rd</sup> August, 2014.

Meat consumption pattern was studied through a structured questionnaire. The survey revealed that the majority of respondents (55%) ate meat whenever they feel and 23% ate only on weekends. About 61% ate 100-200 g of meat in each occasion. Only 1% and 29% ate > 300 g and 200-300 g of meat, respectively. Chicken was the most frequently consumed meat (86 %). 70% of the respondent were willing to buy fresh meat only and they revealed that fresh meat was better to taste, healthy and cheaper. Only about 9% preferred to buy fresh and chilled meat.

Cheese chicken cubes - a novel chicken product was developed with Mozzarella cheese. The finished product weighed about 24 g. The aerobically packaged product was stable at refrigerated storage condition ( $4 \pm 1^{\circ}\text{C}$ ) for 20 days.





### Cheese chicken cubes

#### Quality attributes of cheese chicken cubes at refrigerated storage condition

Quality parameters	Storage period (Days)				
	0	5	10	15	20
pH	6.22 ± 0.01	6.20 ± 0.01	6.19 ± 0.01	6.19 ± 0.05	6.18 ± 0.03
TBA (mg malonaldehyde /kg)	0.233 <sup>a</sup> ± 0.002	0.260 <sup>ab</sup> ± 0.007	0.284 <sup>bc</sup> ± 0.025	0.303 <sup>cd</sup> ± 0.028	0.324 <sup>d</sup> ± 0.01
TPC (log/g)	2.15 <sup>a</sup> ± 0.07	2.79 <sup>b</sup> ± 0.15	3.39 <sup>c</sup> ± 0.13	3.65 <sup>c</sup> ± 0.17	3.71 <sup>c</sup> ± 0.18
PPC (log/g)	0.22 <sup>a</sup> ± 0.22	1.45 <sup>b</sup> ± 0.30	2.23 <sup>c</sup> ± 0.09	2.11 <sup>c</sup> ± 0.46	2.44 <sup>c</sup> ± 0.29

## 5.3 CONTRACT RESEARCH PROJECTS

**5.3.1 Project title** : Evaluating efficacy of TRIOZ decontamination system on carcass and meat quality (Eesavyasa Technologies Pvt. Ltd, Hyderabad)

**Principal investigator** : Dr.A.R.Sen, Principal Scientist

**Co-PIs** : Dr. M. Muthukumar and Dr.B.M. Naveena

Dipping chicken carcass in 10 ppm ozonated water for 20 minutes (Fig 1) resulted in significant ( $P < 0.05$ ) reduction in pathogenic bacteria. About one log reduction was found in *Coliforms*, *Enterobacteriaceae* and *Salmonella* count in ozone treated carcass as compared to chicken carcass dipped in potable water. However, combining the pulsed UV (10 kHz) and ultrasonic (4 watts) with the ozone did not show any additional reduction in microbial counts compare to ozone alone.



**Fig 1. Chicken carcass dipped in ozonated water**

A significant reduction in COD of ruminal content and blood was observed after treating with UV, ozone and microwave (Fig 2). Further reduction was also noticed after final carbon filtration.



**Fig 2. COD reduction at different stages of treatment and clear final discharge water**

## Effect of ozone and other hurdles on COD (mg/lit) of slaughterhouse effluents

Treatment	COD (mg/lit)	
	Ruminal content	Blood
C	169.60 <sup>a</sup>	166.40 <sup>a</sup>
T1	156.80 <sup>b</sup>	133.33 <sup>b</sup>
T2	43.73 <sup>c</sup>	23.46 <sup>c</sup>

C-Control; T1-Treatment with UV, ozone and microwave and T2-Final carbon filtration

**5.3.2 Project title** : Characterization and evaluation of natural antioxidants extracted from different spices in ground chicken and pork (Kancor Ingredients Pvt. Ltd., Kerala)

**Principal investigator** : Dr. B.M. Naveena, Senior Scientist

**Co-PI** : Dr. S. Vaithyanathan

The study demonstrated the protective effect of Oxikan<sup>®</sup> (2.8% carnosic acid and 0.55% carnosol) at different dosage levels against lipid oxidation in raw and cooked pork and chicken patties during storage at refrigeration ( $4 \pm 1^{\circ}\text{C}$ ) under aerobic packaging conditions. Oxikan<sup>®</sup> is also effective in protecting the colour and exhibited significant antimicrobial activity. Ascorbic acid alone did not provide a sufficient protection against lipid oxidation and discolouration of ground pork patties compared to Oxikan<sup>®</sup>. Therefore, Oxikan<sup>®</sup> may be useful as a natural preservative and protectant in ground pork patties and provides suitable alternative to synthetic antioxidants.

## 6. PUBLICATIONS

### 6.1 Research papers

1. Kiran, M., Naveena, B.M., Sudhakar Reddy, K., Shashikumar, M., Ravinder Reddy, V., Kulkarni, V.V., Srikanth, R. and Tushar, H. M. (2015). Muscle-specific variation in buffalo (*Bubalus bubalis*) meat texture: Biochemical, ultrastructural and proteome characterization. *Journal of Texture Studies* (DOI: 10.1111/jtxs.12123)
2. Muthukumar, M., Naveena, B.M., Vaithiyanatahn, S., Sen, A.R. and Sureshkumar, R. (2014). Effect of incorporation of *Moringa oleifera* leaves extract on quality of ground pork patties. *Journal of Food Science and Technology*, 51: 3172-3180.
3. Naveena, B.M. and Kiran, M. (2014). Buffalo meat quality, composition and processing characteristics: Contribution to the global economy and nutritional security. *Animal Frontiers*, 0029: 18-24.
4. Naveena, B.M., Muthukumar, M., Kulkarni, V.V., Praveen Kumar, Y., Usha Rani, K. and Kiran, M. (2015). Effect of ageing on physico-chemical, textural, microbial and proteome changes in emu (*Dromaius novaehollandiae*) meat under different packaging conditions. *Journal of Food Processing and Preservation* (Doi No. 10.1111/jfpp.12499).
5. Naveena, B.M., Muthukumar, M., Sen, A.R., Praveen Kumar, Y. and Kiran, M. (2014). Use of cinnamaldehyde as a potential antioxidant in ground spent hen meat. *Journal of Food Processing and Preservation* 38: 1911-1917.
6. Papri Pal, Chatlod L.R. and Avasthe R.K. (2014). Gastrointestinal parasites of yaks from Katao valley in North Sikkim, India. *Indian Journal of Animal Sciences* 84 (7): 747-749.
7. Papri Pal, Chatlod L.R. and Avasthe R.K. (2014). Epidemiology of *Haemonchus contortus* infection in goats in Sikkim. *Indian Journal of Animal Sciences* 84 (8): 829-832.
8. Papri Pal, Chatlod L.R., Kumar B. and Avasthe R.K. (2015). Prevalence of oesophagostomosis in goats in humid North-East Himalayan region Sikkim, India. *Indian Journal of Animal Sciences* 85(2): 148-150.
9. Purushothaman, C.S., Sudhir Raizada, Sharma, V.K., Harikrishna, V., Venugopal, G., Rahamana, Agrahari, R.K. and Hasan, J. (2014). Production of tiger shrimp (*Penaeus monodon*) in potassium supplemented Inland Saline sub-surface water. *Journal of Applied Aquaculture* 26:84-93.
10. Ravi, T., Shashi Kumar, M., Muthukumar, M., Sudhakar Reddy, K. and Krishnaiah, N. (2014). Effect of irradiation and curry leaves extract on quality attributes and shelf life of chicken emulsion, *Journal of Meat Science*, 10(1): 60-67.

11. Sen, A.R., Naveena, B.M., Muthukumar, M. and Vaithiyanathan, S. (2014). Colour, myoglobin denaturation and storage stability of raw and cooked mutton chops at different end point cooking temperature. *Journal of Food Science and Technology*, 51: 970-975.
12. Sudhir Raizada, Purushothaman, C. S. , Sharma, V. K., Harikrishna, V., Rahamana, M., Agrahari, R. K., Hasan, J., Venugopal, G. and Kumar, A. (2014) Survival and growth of tiger shrimp (*Penaeus monodon*) in inland saline water supplemented with potassium. *Proceedings of National Academia of Science India. Section B. Biological Sciences* DOI10.1007s4001-014-037-1
13. Sunil Kumar, K., Nadeem Fairoze, Muthukumar, M. and Naveena, B.M. (2014). Organochlorine pesticide residues in broiler and desi chicken meat of Hyderabad. *Journal of Meat Science* 10(1): 68-73.
14. Suresh Babu, P.P., Razvi, S.S.H., Venugopal, G., Ramireddy, P., Muralimohan, K., Srinivasa Rao, P., Patnaik, R.R.S., Narasimhacharyulu V. and Ananthan, P.S. (2014). Growth and production performance of Pacific white leg shrimp *Litopenaues vannamei* in low stocking short term farming in earthen pond conditions. *Indian Journal of Fisheries* 61(4): 67-71.
15. Vaithiyanathan, S., S. Saravanakumar, P. Baswa Reddy and C. Ramakrishna. (2015). Seasonal variation in fibre degrading enzymes activities in the rumen contents of slaughtered sheep, goat and buffalo. *Animal Nutrition and Feed Technology* 15:111-120.

## 6.2 Presentation in Conference/ Symposia/Seminar

### a. Lead papers/ Invited lectures

1. Kulkarni, V.V. and Muthukumar, M. (2014). Thermal processing of meat and meat products. National Conference on "Opportunities and Strategies for Sustainable Pig Production" 20<sup>th</sup> - 21<sup>st</sup> December, 2014, ICAR- National Research Centre on Pig, Rani, Guwahati, Assam.
2. Kulkarni, V.V. and Muthukumar, M. (2015). Implications of veterinary public health risks in the trade of foods of animal origin – Meat and meat products. XIII Annual Conference of Indian Association of Veterinary Public Health Specialists (IAVPHS) and National Symposium on "Safety of foods of animal origin for domestic and export markets: Legal perspectives" 10<sup>th</sup> -12<sup>th</sup> February, 2015, Veterinary College, Bengaluru.
3. Kulkarni, V.V. and Muthukumar, M. (2015). Value addition of native chicken for niche market. National Conference on "Native chicken production: Challenges and opportunities" 4<sup>th</sup> -5<sup>th</sup> September, 2014, Tamil Nadu Veterinary and Animal Sciences University, Chennai.



4. Kulkarni, V.V. and Naveena, B.M. (2014). Indian Meat Industry: Concerns, achievements and way ahead. 6<sup>th</sup> Conference of Indian Meat Science Association and National Symposium on “Sustainable meat production for nutritional security and consumer well-being: Challenges and strategies”, 28<sup>th</sup> -30<sup>th</sup> November, 2014, College of Veterinary Sciences, Mathura.
5. Muthukumar, M and Chatlod, L.R. (2014). Chemical safety of meat and meat products. 6<sup>th</sup> Conference of Indian Meat Science Association and National Symposium on “Sustainable meat production for nutritional security and consumer well-being: Challenges and strategies”, 28<sup>th</sup> -30<sup>th</sup> November, 2014, College of Veterinary Sciences, Mathura.
6. Muthukumar, M. and Rajkumar, R.S. (2014). Scientific meat production and management for improved livelihood security of rural farmers. Model training course on “Sustainable conservation technologies for enhancing resource use efficiency in rain fed farming, 23<sup>rd</sup> September, 2014, CRIDA, Hyderabad.
7. Naveena, B.M. (2014). New Innovations in Fresh Poultry Meat Technology. National Congress on Veterinary Public Health and National Symposium on: Food Security and Public Health: Present Status and Future Road Map, 24<sup>th</sup> - 25<sup>th</sup> November, 2014, NASC Complex, New Delhi.
8. Naveena, B.M. and Kiran, M. (2014). Proteomic tools for understanding and improving meat quality. 6<sup>th</sup> Conference of Indian Meat Science Association and National Symposium on “Sustainable meat production for nutritional security and consumer well-being: Challenges and strategies”, 28<sup>th</sup> - 30<sup>th</sup> November, 2014, College of Veterinary Sciences, Mathura.
9. Vaithyanathan, S and Girish Patil, S. (2014). Recent advances in the meat species identification. Interactive Meet on “Strategies for improvement in quality and quantity meat production from small ruminant rearing system”, 21<sup>st</sup> February 2015, CSWRI, Avikanagar, Rajasthan.

## **b. Abstracts**

1. Baswa Reddy, P., Ramana, D.B.V., Sushma K. and Naveena, B.M. 2014. Effect of selenium supplementation to growing lambs on meat quality and fatty acid profiles in meat. Global Animal Nutrition Conference-2014 (Glance-2014) organized by the 'Animal Nutrition Society of India' from 20<sup>th</sup> to 22<sup>nd</sup> April, 2014 at Bengaluru.
2. Baswa Reddy, P., Ramana, D.B.V., Sushma K. and Naveena, B.M. 2014. Effect of dietary zinc supplementation on carcass characteristics and meat quality in sheep. Global Animal Nutrition Conference-2014 (Glance-2014) organized by the 'Animal Nutrition Society of India' from 20<sup>th</sup> to 22<sup>nd</sup> April, 2014 at Bengaluru.

3. Kiran, M., Naveena, B.M., Sudhakar Reddy, K., Shashikumar, M. and Ravinder Reddy. (2014). Assessment of variability in different quality attributes of buffalo meat. "6<sup>th</sup> Conference of Indian Meat Science Association and National Symposium", held at College of Veterinary Sciences, Mathura from 28<sup>th</sup> - 30<sup>th</sup> November, 2014 (Abstract No. CFMQ 16, Page 189).
4. Muthukumar, M., Naveena, B.M., Sen, A.R., Ramakrishna, C. and Kulkarni, V.V. (2014). Quality attributes of mutton nuggets formulated with modified soyproteins. "6<sup>th</sup> Conference of Indian Meat Science Association and National Symposium" held at College of Veterinary Sciences, Mathura from 28<sup>th</sup> - 30<sup>th</sup> November, 2014 (Abstract No. MQM 18, Page 244).
5. Muthukumar, M., Vaithyanathan, S. Naveena, B.M., and Kulkarni, V.V. (2014). Organochlorine pesticide residues in various chicken meat products. "6<sup>th</sup> Conference of Indian Meat Science Association and National Symposium" held at College of Veterinary Sciences, Mathura from 28<sup>th</sup> - 30<sup>th</sup> November, 2014 (Abstract No. MB 28, Page 278)
6. Naveena, B.M., Usha Rani, K., Praveen Kumar, Y., Kulkarni, V.V. and Kiran, M. (2014). Proteome characterization, thermostability and lipid oxidation induced oxidation of goat meat myoglobin. "6<sup>th</sup> Conference of Indian Meat Science Association and National Symposium" held at College of Veterinary Sciences, Mathura from 28<sup>th</sup> - 30<sup>th</sup> November, 2014 (Abstract No. MB 01, Page 267).
7. Naveena, B.M., Vaithyanathan, S., Muthukumar, M., Kulkarni, V.V., Praveen Kumar, Y., Usha Rani, K., Shaju, V.A., Ramesh Chandran, R., Rajeesh, K.A. (2014). Rosemary diterpene mixture: Concentration and dose dependent antioxidative effect in ground pork patties compared to ascorbic acid. "6<sup>th</sup> Conference of Indian Meat Science Association and National Symposium" held at College of Veterinary Sciences, Mathura from 28<sup>th</sup> - 30<sup>th</sup> November, 2014 (Abstract No. NTMPP 10, Page 250).
8. Sushma, K., Ramana Reddy, Y., Nalini Kumari, N., Raghunandan, T. and Baswa Reddy, P. 2014. Effect of different dietary levels of selenium on immunity and keeping quality of meat in growing Nellore ram lambs. 2<sup>nd</sup> International Conference on Animal and Dairy Sciences. September 15<sup>th</sup> - 17<sup>th</sup>, 2014 Hyderabad International Convention Centre, India
9. Vaithyanathan, S. 2014. "DNA extraction from cow milk fat and tallow for species identification through PCR assay" presented in the International Scientific Conference on Environmental Research: Issues, Challenges and Strategies for Sustainable Development and livelihood Security, 1<sup>st</sup> to 3<sup>rd</sup> November 2014 at Lumbini, Nepal.
10. Venugopal, G., Muthukumar, M., Baswa Reddy, B., Madhuri, S. and Kulkarni, V.V. 2014. Organochlorine pesticide residues in pond reared food fish – Rohu, of Kolleru lake region



of Andhra Pradesh. "6<sup>th</sup> Conference of Indian Meat Science Association and National Symposium" held at College of Veterinary Sciences, Mathura from 28<sup>th</sup> - 30<sup>th</sup> November, 2014 (Abstract No. MB 20, Page 274)

11. Papri Pal, Chatlod, L.R., Avasthe, R.K., Rahman, H., Bandyopadhyay, S. and Kumar, B. (2014) Gastrointestinal parasitic infections in yaks at different farms of Sikkim, a North-East humid Himalayan region of India. 13<sup>th</sup> International Congress of Parasitology, 10<sup>th</sup> -15<sup>th</sup> August, 2014, at Camino Real Hotel Mexico City.
12. Chandra, R., Dabas, S. K., Chatlod, L. R. and Rahman H. (2015). Effect of supplementary feeding on fertility, litter size and litter weight of sikkim local goat. pp-174 In: Compendium, XII Agricultural Science Congress, Sustainable Livelihood security for smallholder farmers, 3<sup>rd</sup> - 6<sup>th</sup> Feb, 2015, ICAR-NDRI, Karnal, Haryana.

### 6.3. Folders/Brochure

1. Vaithyanathan, S and Kulkarni, V.V. 2014. Detection of meat and fat adulteration through PCR assay. Published by ITMU, NRC on Meat, Hyderabad
2. Vaithyanathan, S., Muthukumar, M. and Kulkarni, V. V. 2014. Tasty and tender chicken: Ways and means. Published by ITMU, NRC on Meat, Hyderabad.
3. Ramakrishna, C., Chatlod, L.R., Vaithyanathan, S., Muthukumar, M. and Lavanya, P. 2014. Please protect me from Sarcocysts (English, Hindi and Telugu).
4. Muthukumar, M., Baswa Reddy, P. and Kulkarni, V.V. 2014. Meat and Health.
5. Technology for meat and meat products (Hindi). Published by ITMU, NRC on Meat, Hyderabad

### 6.4 Books/ Book Chapter

- Girish Patil, S., Kulkarni V.V, Sen, A.R. and Muthukumar, M. (2014). Animal Identification and Meat Traceability: An Indian Perspective, National Research Centre on Meat, Hyderabad.

### 6.5 Participation in Conferences/ Seminars/ Symposia

1. Dr. P. Baswa Reddy attended the Global Animal Nutrition Conference-2014 held at Bangalore during 20<sup>th</sup> -22<sup>nd</sup> April, 2014.
2. Dr. L. R. Chatlod attended the workshop on "Priority setting, monitoring and evaluation in National Agricultural System: Status, Experiences and way forward" on 27-05-2014 at NASC Complex, New Delhi.

3. Dr. V.V. Kulkarni attended National Conference on “Recent Trends in Processing, Quality and Safety of Ethnic and Organic Foods” held at Kuduvali, TANUVAS, Chennai on 26<sup>th</sup> June, 2014.
4. Dr. V.V. Kulkarni attended the 22<sup>nd</sup> ICAR Regional Committee Zone-II Meeting held at CIFRI, Kolkata during 27<sup>th</sup> - 28<sup>th</sup> June, 2014.
5. Dr. B. M Naveena and Dr. M. Muthukumar have participated in “Meat Tech-2014” on “Emerging Trends and Technologies for Meat and Poultry Processing Industry” organized by Tamil Nadu Technology Development & Promotion Centre of Confederation of Indian Industry (CII) on 27<sup>th</sup> June, 2014 at Chennai.
6. Dr. M. Muthukumar and Dr. B. M. Naveena participated in three day International exhibition “Meat Tech Asia-2014” at Bangalore International Exhibition Centre, Bangalore from August 22<sup>nd</sup> - 24<sup>th</sup>, 2014.
7. Dr. S. Vaithyanathan attended IMC meeting of NRC on Meat and presented the achievements and ongoing research projects on 26.8.2014 at NRCM, Hyderabad.
8. Dr. M. Muthukumar presented the achievements of ITMU of NRC on Meat at the Annual meeting cum workshop organized by Zonal Technology Management Unit, South Zone, CIFT, Cochin from 9<sup>th</sup> - 10<sup>th</sup> October, 2014 at IIHR, Bangalore.
9. Dr. B. M. Naveena participated in “National Congress of Veterinary Public Health Meeting” at Bangalore New Delhi during 24<sup>th</sup> - 25<sup>th</sup> November, 2014.
10. Dr. M. Muthukumar presented half yearly RFD achievements of NRC on Meat on 27<sup>th</sup> November, 2014 at NAS complex, New Delhi.
11. Dr. V.V. Kulkarni, Dr. B. M. Naveena and Dr. M. Muthukumar attended the VI<sup>th</sup> Conference of Indian Meat Science Association and National Symposium (IMSACON-VI) organised by Dept. of LPT, College of Veterinary Sciences, DUVASU, Mathura during November 28<sup>th</sup> - 30<sup>th</sup>, 2014.
12. Dr. S. Vaithyanathan attended meeting PME cell Incharges of ICAR institutes of Hyderabad on 24.12.2014 at NAARM, Hyderabad.
13. Dr. M. Muthukumar, participated the XIII Annual Conference of Indian Association of Veterinary Public Health Specialists (IAVPHS) and National Symposium on “Safety of foods of animal origin for domestic and export markets: Legal perspectives organized by Veterinary College, Bengaluru during 10<sup>th</sup> - 12<sup>th</sup> February, 2015.

## 7. AWARDS AND RECOGNITIONS

1. Dr. Naveena, B.M. has been awarded with Lal-Bahadur Shastri Outstanding Young Scientist Award-2013 on 29<sup>th</sup> July, 2014 during the 86<sup>th</sup> ICAR Foundation Day and ICAR Award Ceremony held at New Delhi.



**Dr. Naveena, B.M. receiving the young scientist award from Hon'ble Minister of Agriculture Shri. Radha Mohan Singh**

2. Research Paper entitled "Proteome characterization, thermostability and lipid oxidation induced oxidation of goat (*Capra hircus*) meat myoglobin by Naveena, B.M. et al. received Best Paper (First Prize) Award at VI Conference of Indian Meat Science Association and National Symposium organized by Dept. of LPT, College of Veterinary Sciences, DUVASU, Mathura from November 28<sup>th</sup> - 30<sup>th</sup>, 2014.
3. Shri Chandrashekhar, AAO was elected as Secretary (SS), CJSC, ICAR.

### Students Corner

1. Dr. Deepak, S.J.(M.V.Sc scholar, Dept. VPH, Veterinary College, Hyderabad) On-going theses work: A proteomic-based approach to differentiate sheep meat with buffalo meat
2. Dr. Panjab Shivhari Khansole (M.V.Sc scholar, Dept. LPT, Veterinary College, Hyderabad) On-going theses work: Effect of rosemary dirterpene phenols on the quality and storage stability of sous-vide cooked chicken sausage
3. Dr. V Rayala Reddy (M.V.Sc scholar, Dept. of Poultry Science, College of Veterinary Science , Hyderabad) On-going theses work: Effect of dietary supplementation of antibiotic growth promoters (Oxytetracyclines, Chlortetracycline) on the performance of broilers and presence of their residues in edible tissues.

### In-plant Training:

4. Post graduate students Dr.Panjab S Khansole and Dr. N. Anitha from Dept. of Livestock Products Technology, College of Veterinary Sciences, Hyderabad have undergone inplant training from 27<sup>th</sup> January to 2<sup>nd</sup> February, 2015.

## 8. WORKSHOPS/TRAININGS/AWARENESS PROGRAMMES ORGANISED

### I. Training for veterinarians from animal husbandry department

Seven veterinary doctors from Department of Animal Husbandry, Government of Andhra Pradesh have undergone 3 days training program on “Management of Modern abattoir” from 19<sup>th</sup> to 21<sup>st</sup> May, 2014.



**Practical demonstration on meat inspection and hygienic meat production**

### II. Workshop on sexual harassment at work place

Workshop on “Sexual Harassment at Workplace” was organized on 6<sup>th</sup> May, 2014. Smt. M. Vijayadevi, Advocate, Vinisha Associates, Hyderabad delivered the lecture and interacted with all the staff of the Institute.



**Staff of NRC on Meat participated in workshop**



### III. Awareness programme

An awareness programme on “Nutritional interventions for augmenting meat production in sheep” was conducted on 4<sup>th</sup> June 2014. A total of 35 participants comprising of farmers, entrepreneurs and officials of Government departments covering Adilabad, Nizamabad, Medak, Warangal, Nalgonda, Mahaboobnagar, Khammam, Hyderabad and Ranga Reddy districts of Telangana participated in the programme.



**Director NRC on Meat addressing the participants**

### IV. National workshop on traceability

A National workshop on “Implementation of Livestock/Meat Traceability in India” was organized on 4<sup>th</sup> August, 2014 in collaboration with Indian Meat Science Association. Around 50 participants from export meat Industry, NDDDB, Cooperatives, NABARD, Academy and Students participated in the event. A brainstorming session was also held during the workshop.



**National workshop held at NRC on Meat**

## V. Awareness program organised at BIEC, Bangalore

In an efforts to popularize clean meat production, value addition and entrepreneurship development, NRC on Meat organized an awareness program during Meat Tech Asia-2014 at Bangalore International Exhibition Centre, Bangalore in the afternoon of 22<sup>nd</sup> August, 2014.



**Awareness program held at BIEC, Bangalore**

## VI. Awareness program for NEH region

NRC on Meat, Hyderabad in collaboration with ICAR Research Complex, Barapani, organised an awareness program on “Meat processing potential at north-eastern states” at ICAR Research Complex, Barapani, Shillong on 18<sup>th</sup> September, 2014.



**Director, NRC on Meat addressing the participants**

## VII. Interactive meeting with stakeholders of NEH region

Interactive meeting with stakeholders on “Status and requirements of meat sector in the NEH states” was organized by NRC on Meat, Hyderabad in collaboration with NRC on Pig, Guwahati on 19<sup>th</sup> August, 2014 at NRC Pig campus, Rani, Guwahati under research program “Entrepreneur development, capacity building and survey of meat production and meat products preparation in NEH region” sanctioned during XII plan. 23 stakeholders comprising, officials from state Animal Husbandry Departments, Entrepreneurs, Meat processors and scientists from ICAR Institutes participated in the meeting.



**Delegates of the Interactive meeting with stakeholders of NEH region**

## VIII. Entrepreneurship training

A three day paid entrepreneurial training program on “Development of value added meat products” was successfully conducted from September 22<sup>nd</sup> - 24<sup>th</sup>, 2014. Dr. Meenakshi Singh, Scientist, FSSAI, Govt. of India was the chief guest and distributed certificates to the trainees.



**Participants of entrepreneurship training program**



## IX. Entrepreneurship training

A three day paid entrepreneurial training program on “Development of value added meat products” was conducted from January 27<sup>th</sup>-29<sup>th</sup>, 2015.



Participants of entrepreneurship training program

## 9. MEETINGS/EVENTS ORGANIZED

### I. Institute Research Council (IRC) meeting

The 9<sup>th</sup> Institute Research Council (IRC) meeting of NRC on Meat was held on 5<sup>th</sup> May, 2014 under the chairmanship of Dr. V.V. Kulkarni, Director, NRC on Meat in the committee room. Dr. U.K. Pal, Professor & Head, Dept. Livestock Products Technology, Rajiv Gandhi College of Veterinary Sciences, Puducherry was the external expert.



9<sup>th</sup> IRC meeting held at NRC on Meat

### II. Research Advisory Committee (RAC) meeting

The NRC on Meat conducted the 7<sup>th</sup> Research Advisory Committee meeting on 9<sup>th</sup> May, 2014 under the chairmanship of Dr. A.S. Bawa, Former Director, Defence Food Research Laboratory, Mysore.



Chairman and members of RAC committee with NRC on Meat scientists

### III. Review meeting

Final review meeting of Ministry of Statistics & Program Implementation funded research project “A Study on State wise Yield of Meat & Byproducts of Cattle, Buffalo, Sheep, Goat, Pig & Poultry” was held on 10<sup>th</sup> May, 2014 at NRC on Meat. Shri. Kumar Sundaram, Deputy Director, Central statistical office, MoSPI, New Delhi and Ms. V. Prathima, JD, Directorate of Economics & Statistics, Govt. of AP, Hyderabad, and associated scientists from collaborative centres attended and reviewed the work.



Participants of review meeting

### IV. Half yearly Institute Research Council meeting

The half yearly Institute Research Council meeting for the year 2014-15 was held on 11.11.2014 at NRC on Meat, Hyderabad. Dr. Md Nadeem Fairuze, Professor and Head, Department of Livestock Products Technology, Veterinary College, Bangalore acted as the external expert member.

### V. Institute Animal Ethics Committee meeting

Institute Animal Ethics Committee (IAEC) meeting was conducted on 14<sup>th</sup> March, 2015 and got approval for the proposed animal experiments and slaughter of animals under different projects of the institute.



Institute Animal Ethics Committee meeting



## VI. ICAR foundation day celebrations

As a part of 86<sup>th</sup> ICAR foundation day, National Research Centre on Meat, Hyderabad has organized a “Consumer Awareness on Importance of Meat and its Health Benefits” on 16<sup>th</sup> July, 2014. Dr. Amarendra Reddy, Director, Institute of Preventive Medicine (IPM) and FSSAI, Hyderabad was chief guest of the function and Dr. Y. Thirupataiah, Addl. Director, Dept. Animal Husbandry, Govt. Telangana and Dr. Subash Chandra, Deputy General Manager, NABARD, Hyderabad were guest of honours.



**Dr. Amarendra Reddy, Director IPM, Hyderabad addressing the participants**

## VII. Independence day celebrations

Director, NRC on Meat unfurled the National flag on 15<sup>th</sup> August, 2014. Staff of NRC Meat and their family members participated in the celebration.

## VIII. Launching of “Meat on Wheels” and awareness programs on value added meat products

On the eve of World Food Day celebration on 16<sup>th</sup> October, 2014 a newly designed “Meat on Wheels” vehicle for promotion and popularization of value addition, meat processing and clean meat production among consumers and meat processors was flagged-off at NRC on Meat. The vehicle was designed under the project “Awareness on clean meat production and value addition” sanctioned from Directorate of Animal Husbandry, Government of Telangana under Rashtriya Krishi Vikas Yojana (RKVY) scheme 2013-14.



**Meat on wheels flagged-off by Dr. R.N. Chatterjee and Dr. Tirupathaih**

## IX. Awareness programs

Series of awareness programs on importance of value addition and role of meat products in human nutrition are being organised in Hyderabad city viz, NAARM, Rajendranagar on 13/11/2014, Gulmohar Garden, Mallapur, and Silveroak township, Cherlapally.



**Awareness programs held at different places in Hyderabad**

## X. Celebration of Hindi Saptah

Hindi saptah was celebrated at NRC on Meat from September 22<sup>nd</sup> to 27<sup>th</sup>, 2014. Different events including debates, essay writing, singing, storytelling etc. were organised during the week and prizes were distributed on the concluding day. Mr. Jitendra Goel, Traffic Commissioner, Hyderabad has graced the function as chief-guest and Dr. Varaprasad, Director, Directorate of Oilseeds Research, Hyderabad and Shri. Arun Kumar Mandal, Rajbhasha Officer at South Central Railways, Hyderabad were the guests of honour during the valedictory program of Hindi saptah.



**Dignitaries releasing the NRC on Meat Technologies brochure in Hindi**

## XI. World food day

National Research Centre on Meat, Hyderabad celebrated the World Food Day on 16<sup>th</sup> October, 2014. Dr. R.N. Chatterjee, Director, Directorate of Poultry Research, Hyderabad, acted as chief-guest and Dr. Y. Thirupathaiah, Additional Director, Dept. A.H., Govt. Telangana and Shri. Mohd. Abdul Majeed, President of Hyderabad Haleem Association and MD, PISTA House, Hyderabad acted as guest-of honours. During the program a brochure on “Detection of meat and animal fat adulteration” and video CD of NRC on Meat in Telugu version were released.



**Dr. V.V. Kulkarni, Director, NRC on Meat during the inaugural address**

## XII. Vigilance week

Vigilance week was celebrated from October 27<sup>th</sup> to November 1<sup>st</sup>, 2014. On 27/10/2014, Dr. V.V. Kulkarni, Director, NRC on Meat administered the oath to all the staff members of NRC on Meat followed by presentation on Vigilance by Mr. Suresh Kumar, Retd. CAO, NAARM.



**Staff of NRC on Meat taking oath during vigilance week**



### XIII. NRC on Meat foundation day

The VIII Foundation day was celebrated on 22<sup>nd</sup> February, 2015. Dr. D. Rama Rao, Director, NAARM, Hyderabad as a chief guest delivered foundation day lecture and Dr. Manohar Rao, Chairman, VIVIMED laboratory, Hyderabad and Dr. Krishnama Chari, President, Andhra Pradesh Veterinary Council were guests of honours. Good number of meat processors, meat exporters, butchers were also attended the function.



**NRC on Meat celebrated 8<sup>th</sup> foundation day**

### XIV. NRC on Meat celebrated republic day

Director, NRC on Meat unfurled the National Flag on 26<sup>th</sup> January, 2015 in the premises of NRC on Meat, Chengicherla. Staff of NRC Meat and their family members participated in the celebration.



**Republic day celebrations**



## 10. TRANSFER OF TECHNOLOGY/ CONSULTANCY/ CONTRACT PROJECTS/ EXHIBITIONS

### 10.1 Consultancy

1. Mr. Vivekanandan, Lakshmi Engineering Works, Chennai, Tamil Nadu has signed MoU with NRC on Meat, Hyderabad on 16/05/2014 seeking consultancy for establishment of slaughterhouse for large and small animals.



**Director, NRC on Meat signing MoU with Lakshmi Engineering works,  
Chennai, Tamil Nadu**

2. Dr. Nagesh, Veteran Laboratories, Bangalore signed an MoU with NRC on Meat, Hyderabad on 21/11/2014 seeking consultancy for establishment of rendering plant for utilization of slaughterhouse byproducts for manufacturing pet foods.



**Director, NRC on Meat signing MoU with Veteran Laboratories, Bangalore**

## 10.2 Contract Projects

1. Final report of contract research project on “Effect of modified soy protein on the quality attributes of meat products” was submitted to PRARAS Biosciences, Bangalore on 5<sup>th</sup> August, 2014.



**Director, NRC on Meat handed over the final project report to PrARAS Biosciences, Bangalore**

2. Final report of contract research project on “Characterization and evaluation of natural antioxidants extracted from different spices in ground chicken and pork” was submitted to KANCOR Ingredients Pvt. Ltd., Kerala on 16<sup>th</sup> September, 2014 at a meeting held at NRC on Meat, Hyderabad.



**Director, NRC on Meat presenting the final project report to Mr. Ramesh Chandran, Kancor Ingredients Ltd., Kerala**

3. PrARAS Biosciences Pvt Ltd., Bangalore, signed an MoU with NRC on Meat on 19<sup>th</sup> January, 2015 for contract research project on “Effect of texturizer on quality of extended chicken sausages”.

### 10.3 Technology Transfer

1. Shri. Obedullah Quraishi, M/S Tasty Chicken, Kurnool A.P. signed an MoU with NRC on Meat on 22<sup>nd</sup> February, 2015 for transfer of technology for enrobed meat products.



**Shri. Obedullah Quraishi exchanging MoU document with Director, NRC on Meat**

2. Shri. Gulzar Ahmed, M/S Alshifa Frozen Food, New Delhi signed an MoU with NRC on Meat on 22<sup>nd</sup> February, 2015 for transfer of technology for emulsion meat products.



**Shri. Gulzar Ahmed exchanging MoU document with Director, NRC on Meat**



## 10.4 Exhibition

1. National Research Centre on Meat participated in the 'Poultry India-2014' expo organized at HITEX, exhibition grounds, Hyderabad from 26<sup>th</sup> - 28<sup>th</sup> November, 2014.



**NRC on Meat stall at Poultry India-2014, Hitex, Hyderabad**

2. National Research Centre on Meat exhibited its technologies at the Meat Tech Asia-2014 held at Bangalore during 22<sup>nd</sup> - 24<sup>th</sup> August, 2014. The event was organized by Media today group and sponsored by Dept. of Animal Husbandry, Dairying & Fisheries, NMPPB (MoFPI), APEDA, CLFMA of India and FPPMIA.



**NRC on Meat stall at Meat Tech Asia-2014, Bangalore**

## 11. IMPORTANT VISITORS

- Eighteen students from Institute of Poultry Management and Technology, TANUVAS, Hosur visited NRC on Meat on 14<sup>th</sup> July, 2014.
- A group of 14 members including faculty and students from Cornell University, USA visited ICAR-National Research Centre on Meat, Hyderabad on 6<sup>th</sup> January, 2015.



**Faculty and students from Cornell University, USA visited NRCM on 6<sup>th</sup> January, 2015**

- Eight trainees from Extension Education of India (EEI), Hyderabad visited NRC on Meat on 5<sup>th</sup> September, 2014.
- Dr. Suresh S. Honnappagol, Animal Husbandry Commissioner, Department of Animal Husbandry, Dairying and Fisheries, Govt. of India visited NRC on Meat, Hyderabad on 10<sup>th</sup> September, 2014.



**Dr. Suresh Honnappagol, Animal Husbandry Commissioner visited NRC on Meat**



- A group of 50 trainees from NAARM, Hyderabad comprising faculty members from different Universities visited NRC on Meat on 9<sup>th</sup> December, 2014.



**Trainees from NAARM, Hyderabad visited NRC on Meat**

- A group of 6 students from National Institute for Rural Development, Hyderabad visited NRC on Meat on 17/12/2014.
- Shri. Sunil Kumar, General Manager, APEDA visited NRC on Meat, Hyderabad on 27<sup>th</sup> January, 2015.



## 12. INSTITUTE TECHNOLOGY MANAGEMENT UNIT (ITMU)

ITMU is actively involved commercializing the technologies developed by Institute. The Unit has significantly contributed for production of various value added meat products through hands-on-training programs followed by signing MoU with different entrepreneurs. Consultancy processing cell of ITMU processed two consultancy projects, two licensing for technology transfer and one contract research during this period. ITMU has also initiated liaison with other government organizations/Institutes/University. The Unit is always supporting the technical guidance to the farmers and other clients in the area of animal production and meat technology. The unit has published 6 folders on various aspect of meat science and technology to create awareness and also disseminate the technologies developed at the centre.

<b>A. Consultancy</b>				
<b>S.No.</b>	<b>Name of the firm</b>	<b>Type of Agreement</b>	<b>Date</b>	<b>Amount (In rupees)</b>
1.	Mr. Vivekanandan, Lakshmi Engineering Works, Chennai	Establishment of slaughter house for large and small animals	16.5.2014	30,000
2.	Dr.Nagesh, Veteran Lab, Bangalore	Establishment of rendering plant for utilizing Slaughterhouse waste for pet food manufacturing	21.11.2014	30,000 + 12.36 %ST
			<b>Sub total</b>	<b>₹ 60, 000 + ST</b>
<b>B. Technology transfer</b>				
1.	Shri. Obedullah Quraishi, M/S Tasty Chicken Kurnool A.P.518001	Technology for enrobed meat products	22.02.2015	12,000 + 12.36% ST
2.	Shri. Gulzar Ahmed, M/S Alshifa Frozen Food Uttamnagar, New Delhi	Technology for emulsion meat products	22-02-2015	12,000 + 12.36% ST
			<b>Sub total</b>	<b>₹24,000 + ST</b>
<b>C. Contract research project</b>				
	Praras Biosciences Pvt Ltd., Bangalore	Effect of Texturizer on Quality of Extended chicken sausage	19-01-2015	1,68,000 + 12.36% ST
			<b>Sub total</b>	<b>₹1,68,000 + ST</b>

### D. Trainings

S.No.	Name of the training programme	Date	Amount (In rupees)
1.	Management of modern abattoir	19 <sup>th</sup> to 21 <sup>st</sup> May, 2014	7,000
2.	Principles and production of sundried chicken meat products	23 <sup>rd</sup> to 25 <sup>th</sup> Jun, 2014	4,000
3.	Hands on training programme on development of value added meat products	22 <sup>nd</sup> to 24 <sup>th</sup> Sep, 2014	16,000
4.	Hands on training programme on development of value added meat products	27-29 <sup>th</sup> Jan, 2015	10,000 + 12.36% ST
<b>Sub total</b>			<b>37,000 + 1,236 (12.36% ST)</b>

### E. Analytical services:

S.No.	Client	Date	Amount (In rupees)
1.	Police Department, Govt. of Madhya Pradesh		<b>30, 000</b>
<b>Sub total</b>			<b>₹ 30, 000</b>
<b>Grand Total</b>			<b>₹ 3,19,000 + ST</b>

### Total revenue generated:

S. No.	Particulars	Revenue generated (Rs. In lakhs)
1.	Contract Research Projects	1.68
2.	Sale of Products	1.31
3.	MOU/Licensing of Technical know-how	0.24
4.	Consultancy	0.60
5.	Training	0.37
6.	Sample analysis	0.30
	<b>Total</b>	<b>4.50</b>

### 13. SWACHH BHARAT ABHIYAN



National Research Centre on Meat (ICAR), Hyderabad has overwhelmingly responded to the appeal made by Hon'ble Prime Minister of India to take up Swachh Bharat Abhiyan. The Director and all staff members have taken the “pledge” issued by Govt. of India on 2<sup>nd</sup> October, 2014 and launched the mission to make the Centre “Swachh”. A special drive has been initiated by Director to keep the NRCM campus clean by performing one day **Shramdaan on every month**. In order to create awareness of **SWACHH BHARAT ABHIYAN** in the local area, cleaning program was conducted at NRC on Meat, approach road, Chengicherla village on 22<sup>nd</sup> November and 10<sup>th</sup> December, 2014. On this occasion village Gram Panchayat Officials, village elders and leaders have also joined hands for the success of the Swachh mission.





## 14. GREENING OF THE CAMPUS

NRC on Meat has taken new initiatives in greening and to create an aesthetic ambience in the campus during this year. A new water fountain has been installed at the entrance of the main building. Mango orchard housing various varieties and coconut plantations are being developed. A small herbal garden comprising of aromatic and medicinal plants has been developed with the help of CIMAP, Hyderabad. Besides these Mango, Gauva, Ashoka, Thuja, Ganner and many flowering plants have been added in this campus. Staff are regularly sensitized on the judicious use of electricity, paper and water. In order to save energy and water, drip irrigation system has been adopted for greening the campus.



**Mango orchard**



**Drip irrigation system to conserve energy and water**



## 15. NEW ENTRANTS/RETIREMENTS/TRANSFER/PROMOTION

- Dr.A.R. Sen, Principal Scientist went on transfer to CIFE, Kolkatta on 7-6-2014.
- Dr. R.S. Rajkumar, Scientist went on transfer to ICAR Research Complex for Goa on 01-11-2014.
- Dr. Susitha Rajkumar, Scientist went on transfer to ICAR Research Complex for Goa on 13-11-2014.
- Dr. S. Kalpana, Scientist came on transfer from IVRI, Izzatnagar on 02-12-2014
- Smt. G. Prameela Bai, Assistant, retired (Compulsorily) on 02-07-2014.
- Shri S. Rukman, UDC promoted to the post of JAO on 06-08-2014.
- Shri Chandrashekhar, AAO went on transfer to NRC Pig, Guwahati on 02-09-2014.
- Smt. V. Kalpana, UDC came on transfer from DOR, Hyderabad on 22-10-2014.
- Shri Chandrashekhar, AAO came on transfer from NRC Pig, Guwahati on 22-12-2014.

## 16. PERSONNEL

### Scientific, technical and administrative staff

1.	Dr V V Kulkarni	Director
<b>Scientific</b>		
2.	Dr. G. Venugopal	Principal Scientist
3.	Dr. S. Vaithyanathan	Principal Scientist
4.	Dr. A R Sen	Principal Scientist (upto 7-6-2014)
5.	Dr. Y Babji	Principal Scientist
6.	Dr. C Ramakrishna	Senior Scientist
7.	Dr. I Prince Devadason	Senior Scientist
8.	Dr. B M Naveena	Senior Scientist
9.	Dr. M Muthukumar	Senior Scientist

10.	Dr. P Baswa Reddy	Senior Scientist
11.	Dr. L R Chatlod	Scientist
12.	Shri. P Mooventhan	Scientist (on study leave)
13.	Dr. R S Rajkumar	Scientist (upto 1-11-2014)
14.	Dr. K Susitha Rajkumar	Scientist (upto 13-11-2014)
15.	Smt. K Varalakshmi	Scientist
16.	Dr. S.Kalpana	Scientist (from 2-12-2014)
<b>Technical</b>		
1.	Smt. Kanchana Kommi	Technical Assistant
2.	Shri. P Phanikumar	Technical Assistant
3.	Shri. B V D Srinivasa Rao	Senior Technician
4.	Er. Pushpesh Khulbe	Technician
5.	Shri. M Srinivas	Technician
<b>Administrative</b>		
1.	Shri. Chandrashekhar	Asst. Admin. Officer
2.	Shri. M N V Rao	Asst. Finance and Accounts Officer
3.	Shri. B P R Vithal	Personal Secretary (on deputation)
4.	Smt. G Prameela Bai	Assistant (upto 2-7-2014)
5.	Smt. C Padmaja	Personal Assistant
6.	Shri. Nitin Kant Suraj	Assistant
7.	Shri. T Devender	Upper Divisional Clerk
8.	Shri. S Rukman	Junior Accounts Officer (from 6-8-2014)
9.	Smt. V. Kalpana	UDC (from 22-10-2014)

## 17. COMMITTEES

### Institute Management Committee

1. Dr. V.V. Kulkarni, Director, National Research Centre on meat, Hyderabad - Chairman
2. Dr. B.Venkateswaru, Director, Animal Husbandry Department, Govt. of Telangana, Shantinagar, Hyderabad - Member
3. Director, Directorate of Animal Husbandry and Veterinary Sciences, Chennai, Tamil Nadu - Member
4. Dr. K. Sudhakar Reddy, Associate Dean, College of Veterinary Science, SVVU, Hyderabad - Member
5. Dr. M.V.L.N. Raju, Principal Scientist, Project Directorate on Poultry, Hyderabad - Member
6. Dr. S.K. Mendiratta, Head, Division of LPT, IVRI, Izzatnagar, Bareilly, U.P. - Member
7. Dr. Y. Babji, Principal Scientist, NRC on Meat, Hyderabad - Member
8. Dr. S.N. Jha, Principal Scientist, CIPHET, Ludhiana - Member
9. Dr. B.S. Prakash, Asst. Director General (ANP), Indian Council of Agricultural Research, New Delhi - Member
10. Shri D.D. Verma, Comptroller, NAARM, Hyderabad - Member
11. Assistant Administrative Officer, National Research Centre on Meat, Hyderabad - Member

### Research Advisory Committee

1. Dr. A.S. Bawa, Ex-Director, Defence Food Research Laboratory (DFRL), Ministry of Defence, Gol, Mysore – Chairman
2. Dr. Lal Krishna, Ex-Assistant Director General (AH), ICAR, New Delhi - Member
3. Dr. V. Kesava Rao, Professor and Head (Retd), Dept. of LPT, RAGACOVAS, Puducherry - Member
4. Dr. S. Biswas, Professor and Head, Department of LPT, Veterinary College, West Bengal University of Animal and Fisheries Sciences, Kolkata - Member
5. Dr. J. Sahoo, Professor and Head (Retd), Department of LPT, GADVASU, Ludhiana - Member
6. Dr. V.V. Kulkarni, Director, NRC on Meat, Hyderabad - Member
7. Dr. B. S. Prakash, ADG (AN&P), ICAR, New Delhi - Member
8. Shri. Kuppa Ranganayakulu (Ranga Sai) Aakaveedu Village, Racharla Mandal, District: Prakasam (A P) - Member
9. Shri. Dirisala Rajagopala Reddy Chandrapadu Village, Chimakurthy Mandal, District: Prakasam (AP) - Member
10. Dr. S.Vaithyanathan, Principal Scientist, NRC on Meat, Hyderabad - Member Secretary

## Institute Animal Ethics Committee

S. No	Name	Designation
1	Dr V V Kulkarni, Director, ICAR-NRC on Meat, Hyderabad.	Chairman
2	Dr L R Chatlod, Scientist, ICAR-NRC on Meat, Hyderabad.	Scientist form different discipline
3	Dr M Muthukumar, Sr. Scientist, ICAR-NRC on Meat, Hyderabad.	Scientist form different discipline
4	Dr C Ramakrishna, Sr. Scientist, ICAR-NRC on Meat, Hyderabad.	Veterinarian
5	Dr B Dinesh Kumar, Assistant Director, Food & Drug Toxicology Research Centre, National Institute of Nutrition, Hyderabad	Main Nominee
6	Dr Ramakrishna Sistla, Scientist, Pharmacology Division, Indian Institute of Chemical Technology, Hyderabad	Link Nominee
7	Dr P Uday Kumar, Deputy Director National Institute of Nutrition, Hyderabad	Scientist from outside the Institute
8	Shri G Manjunath, International Animal and Birds Welfare Society Gudur, Ananthapur Dist, Andhra Pradesh.	Socially Aware Nominee
9	Dr P Baswa Reddy, Sr. Scientist, ICAR-NRC on Meat, Hyderabad.	Scientist In-Charge cum Member Secretary

